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ERP AND PRODUCTIVITY: A CONCEPTUAL CHARACTERIZATION

Dr. Amol Gore, BRIMS, University of Mumbai, India
dr.amolgore@yahoo.com
Dr. Pekka Kess, IEM, University of Oulu, Finland
pekka.kess@oulu.fi

ABSTRACT

Millions of dollars have been invested in the enterprise applications market with the consideration of ERP systems as key element of an infrastructure that delivers a solution to business, with the hopes of accelerating the productivity growth. As it becomes crucial to mobilize resource capabilities across corporate boundaries, ERP has evolved to include sophisticated modules in e-commerce, customer relationship management and supply chain management.

While there is substantial literature about the general effect of IT and productivity, there is limited specific research on ERP and productivity with ERP as a particular entity. This paper aims to develop a conceptual framework for ERP and productivity that articulates the challenges of ERP in driving productivity. Moreover, this research framework would provide a theoretical ground for advanced enterprise systems conciliation with productivity as it is based on the extensive review of the ERP developments in addition to our prior research.

Keywords: ERP Systems, Productivity, Innovation, Next Generation Enterprise Systems, Agile Networks

INTRODUCTION

Technology is often regarded as the critical dimension of the productivity management models with thrust on innovation (see e.g. Sumanth, 1998; Ark, Kuipers and Kuper, 2000; Hoshi and Jorgenson, 2005). Today, technology and in particular information technology is embedded into most aspects of modern global economic activity. According to Liikanen (2004), information technology is one of the drivers of productivity and is closely linked to innovation. In fact, one of the most important IT-enabled business innovations has been the emergence of enterprise resource planning (ERP) systems.

The ERP systems are developed to provide information backbone needed to support the business decisions. Thereby, ERP is described as software system that integrates application programs in manufacturing, logistics, sales and marketing, finance, human resources and other functions in a firm (Vollmann et al., 2005). Most major companies have implemented ERP systems and are in various phases of ERP maturity. The evolution of the ERP systems has been largely from the material requirements planning (MRP) philosophy to a huge industry today that is expected to grow to $64.8 billion in 2009 as indicated by the recent AMR research. Also, these enterprise systems play a central role in the supply chain management challenges, from integration and collaboration to practices of strategic agile networks.

Although there is substantial literature about the general effect of IT on productivity and some empirical investigations have even attempted to find a relationship between IT

investments and productivity (see e.g. Brynjolfsson and Hitt, 2000; Oz, 2005; Dozier and Chang, 2006; Stiroh and Botsch, 2007), the IT and productivity debate is neither conclusive nor consistent while the ERP and productivity characterization has been obscure as regards the content and the changing status of the phenomenon. There is limited specific research on ERP and productivity with ERP as a particular entity. Moreover, ERP is transforming progressively towards next generation enterprise systems and it is essential to highlight the aspects of productivity in these increasingly consolidating applications. In this paper, our approach is to review the challenges of ERP in driving productivity and to evaluate the productivity links to the next generation applications. This will lead to a conceptual framework that incorporates the factors impacting productivity on implementing ERP systems.

ERP DEVELOPMENT AND PRODUCTIVITY CHALLENGES

While the 1990s focused on the increasing levels of global competition and growing importance of supply chain processes extending across the firms in standard mode of operation (Rondeau and Litteral, 2001), the 2000s further established this form with activated business clusters (see Ketels, 2003; Porter, 2008) and budding agile networks. The clusters stress innovation and productivity improvement whereas the agile networks were proposed to forward similar ideology as a response to uncertain market conditions and ever-changing customer requirements (see Brown and Bessant, 2003; Gore, 2008). Furthermore, the firms recognized the need for strengthening the information systems infrastructure to meet the global directives and achieve customer-oriented information management, thereby investing in ERP systems that promised to deliver on all the fronts. It was not that many of these firms had a choice, because, the dynamics of the new customer-supplier relationships demanded it (Reary, 2000). So, the ERP development can be traced depending on the advances in processes, technology, methodology and organization, depicted as generations of ERP systems (Siau, 2004).

However, the basic ERP's role in driving productivity includes the following responsibilities:

- providing the necessary real-time information so that the employees and managers can optimally run the business
- better integration
- enhanced collaboration
- improved customer service

These responsibilities indicate the necessity of proactively implementing the vision, putting together the information systems strategy with the company strategy, rather than engulfing in the mere mechanics of operating the software. In this context, the debate has been restricted to 'alignment' with the units or in some cases about partnering in planning the organization's future. But, Monat (2006) insists that the IT departments recast themselves and transcend ERP to leadership state in order to maximize corporate productivity. Monat's survey shows that only 6 percent of the companies regard ERP's role as proactive leadership, which means that at least in the early phases of ERP development, the productivity efforts were compromised. This seems likely considering the strategic ERP perspective of business solutions (Shanks et al., 2003; Elbertsen et al., 2006) as opposed to arbitrary installation of new software. Moreover, there is evidence suggesting that ERP had mixed results and the technology had difficulty dealing with the degree of data incompatibility within firms resulting in only partial realization of total information integration (Baily, 2004).

The companies have dealt with the issue of incompatibility in different ways depending on the type of ERP package. There is a broad spectrum of choices and the extent of tailoring efforts have important implications for the risks faced and outcomes realized by companies that implement the ERP systems. The options are off-the-shelf packages, customization, in-house applications, or out-sourcing. But, each option has its pros and cons with regards to costs, implementation time, skills and security. The figure 1 shows the option selected by companies and the productivity results. The study is based on telephone interviews with managers of some companies in Finland. These companies expected ERP to potentially improve inventory control, reduce inventory costs, improve yield, traceability, forecasting and correct sequencing of manufacturing processes.

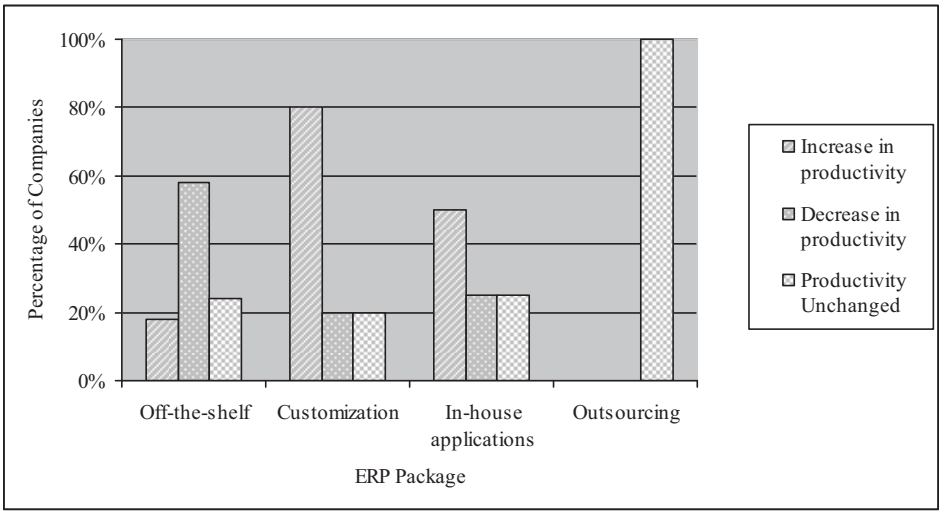

Figure 1 Type of ERP Package and Productivity Effects

Since the sample size in this survey is limited, it is difficult to draw exclusive conclusions but it can be deduced that customized ERP leads to positive productivity outcomes. This result coupled with the modest productivity gains of in-house applications implies that the uniqueness of the organizational processes should normally be captured in the ERP implementation. The pure off-the-shelf implementations fail to comprehend the organization and move away from the goal of providing real-time information, largely negating the productivity. Therefore, the importance of setting parameters in the package to reflect the organizational features and inimitability is underscored. On the other hand, extensive modifications can cause difficulties during upgradation apart from time-consuming and expensive programming, maintenance and post-implementation efforts. According to Zarotsky et al. (2006), the upgradation process can become complex and as risky as the implementation itself. The companies that attempted to build high competitive differentiation to the extent of contemplating legal protection for the resource, actually saw their productivity dip, thus suggesting a trade-off between configuring the system and controllable tailoring risks. Also, the business practices in organizations evolve over time and may not necessarily be efficient but the organization may be unwilling to abandon the practices in favour of the ERP package. Some companies dealt with the trade-off issue by applying 'bolt-on' packages for particular functions or areas that supplemented the organization's existing ERP package. For example, Butler and Meyer (2002) have described the 'bolt-on' for accounts receivable and collection functions that raises the function to the next level. This was seen as a way to attain competitive advantage relative to the companies utilizing the package as-is. So, the 'bolt-on' could be designed to work with the ERP system and provide

industry-specific functionality or even broader expertise such as supply chain management (SCM) and customer relationship management (CRM). According to Grossman (2004), ERP systems have played a critical role in getting organizations to focus on business processes but they have not been as successful integrating processes across the supply chain. The reason could be that the traditional ERP systems did not readily take to e-commerce (Johnson, 2007) and, in order to be internet-ready, they had to be redesigned for being:

- Fully browser enabled
- Available for all corporate users, not just the special few
- Available to trading partners
- Standard data interchange language oriented, rather than proprietary protocols oriented.

In other words, ERP vendors had to completely redesign their applications for a true e-business environment. Most of these are now available as integrated business suites built with open, service-oriented architecture (SOA), web-enabled for e-business. Managers are now focusing more on the internet-enabled collaborative strategies that represent a paradigm shift in the corporate mindset. Earlier, few organizations willingly shared information believing that their own information provides competitive advantage, but, in the collaborative environment, the organizations have to optimize the processes for mutual benefit (Búrca, Fynes and Marshall, 2005). The ability to interact across the supply chain requires crossing the traditional organizational boundaries and inducing visibility in the operations. The exchange of accurate information and progressively trusting business relationships can facilitate enhanced productivity. However, the top management has to view the ERP systems as enabler of collaboration and comprehend the intricacies of collaboration in entirety because, poorly planned efforts at collaboration may be deleterious.

Two other aspects that surfaced from this study were utilization of ERP and organizational changes. The productivity gains come from the ability to apply and utilize the ERP system not just the expensive selection of package, thus drawing parallel to the previous studies of IT and productivity (see Oliner and Sichel, 2002). Research shows that more the understanding of both how day-to-day processes work and the systems capabilities, the more that can be accomplished (Sonde, 2008). However, it takes time to learn and apply new technologies and absorbing ERP in the organization entails transition stages referred to as 'stabilization.' During this period, the competing interests, power transfers, degree of formalization, and appraisal practices remain fluid. The lesson learnt from the ICT sector in Finland is that the productivity impacts of new technologies can be long-delayed. According to Jalava and Pohjola (2007), ICT can be expected to increase productivity by standardizing, automating and outsourcing the work in basically the same way as the assembly line mechanized manufacturing. So, ERP would play the same role as the assembly line did in the transformation of industrial work. The on-going digitalization and outsourcing of business processes could result in the restructuring of the work at global level, consequently bringing about a new wave of productivity growth. Therefore, time is a significant factor that determines the productivity growth achieved specifically by ERP implementation.

ERP AND INNOVATION

There have been some contradictory views suggesting that ERP tends to lock in a certain way of doing things making innovation difficult. However, although acknowledging the dialectical and often complex relationship between ERP systems and innovation, the current research highlights the ERP potential for augmenting knowledge capabilities and leveraging

the enabling elements for innovation (see Srivardhana and Pawlowski, 2007). The ability to harness this ERP potential to drive innovation leading to increased productivity can be the fundamental source of wealth creation in an economy. As the ERP systems are considered from the perspective of enhanced knowledge capabilities they become strongly related to innovation, particularly since innovation today is largely the result of an interactive process of knowledge generation, diffusion and application (Tödtling et al., 2009). The complexity increases when the collaboration with specialized outside partners along with the interplay in the supply chain is conjectured. Dachs, Ebersberger and Pyka (2004) have grouped the different motives for firms to collaborate for innovation as sectoral, strategic and political attributes. Firm's propensity to collaborate is determined by the firm's management of appropriability as well as speed of knowledge generation and utilization processes. Nevertheless, the implication for the organization is in the form of significant investments in training people for ERP systems and it essentially means that the organization is building up intangible capital. Managers have to identify business improvement opportunities and engage knowledgeable people to ensure strategic fit. Sambamurthy et al. (2003) have coined the term 'entrepreneurial alertness' to indicate the management's ability to anticipate strategic opportunities in the marketplace and develop knowledge systems for agility. They define agility as the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise. According to Berente (2005), the agile firm not only responds to moments of opportunity, but also contributes to them through relentless innovation. The important realization is that sustainable value can be created from nurturing intangible assets thereby fostering an innovative organization. Such organization would achieve high productivity and wealth creating capability. Therefore, retaining people trained in ERP environment is a crucial factor coupled to productivity.

CONCEPTUAL FRAMEWORK

The ERP market experienced hype as the systems were looked upon as key driver of productivity with immense opportunities for strategic and operational development. The vendors steadily brought on the scene a host of solutions ranging from isolated technologies and 'bolt-on' applications to extensively consolidated packages. Later, the hype soured as the traditional ERP faced difficulties for e-business transformation. The response was to expand the system and devise modularized architectures to be gradually adopted into the infrastructure of the ERP systems. However, the companies continue to struggle with productivity because of the challenges posed by a number of entities and particularly because the implementation goes beyond just assimilating sophisticated technologies through multiple modules. The conceptual framework of ERP and productivity illustrated in figure 2 consists of two platforms to be elaborated collectively as follows:

1. The Foundation Platform: Six factors and sub-factors impacting productivity on implementing ERP systems.
2. Elements of productivity in the next generation enterprise systems.

In the Table 1, these platforms are decomposed into a set of factors and subsequently explained in the following.

Foundation Platform

This platform forms the core part of the discussion on ERP and productivity since it includes the standard ERP modules such as financials, sales and distribution, logistics, manufacturing,

quality management and human resources, that are the backbone of the system and maps the ERP maturity.

The first factor namely the type of ERP package is directly linked to productivity since our research indicates that applying any of the extremes viz. off-the-shelf and extensively tailored package produces undesirable effects and often drop in productivity. In fact, the implications can range from loss of data to frequent work stoppages and reduced employee morale. So, the customized ERP with necessary but limited modifications can be prescribed as favourable for productivity improvement.

Then, the factor of 'utilization' refers to the ability to comprehend the system, exploit the features and manage the user acceptance. The gap grows between the capabilities offered by the ERP and the extent to which the system is accepted and effectively utilized by the intended users. This could be due to the misalignment of perceived expectation and rewards between users and managers or intimately tied to the sustained fulfillment of the users' cognitive expectations (Lim, Pan and Tan, 2005). In other words, utilization of ERP system at perfunctory level leaves the productivity unchanged at the best and in all likelihood hinders productivity gains. Hence, greater utilization relates positively to productivity advantage.

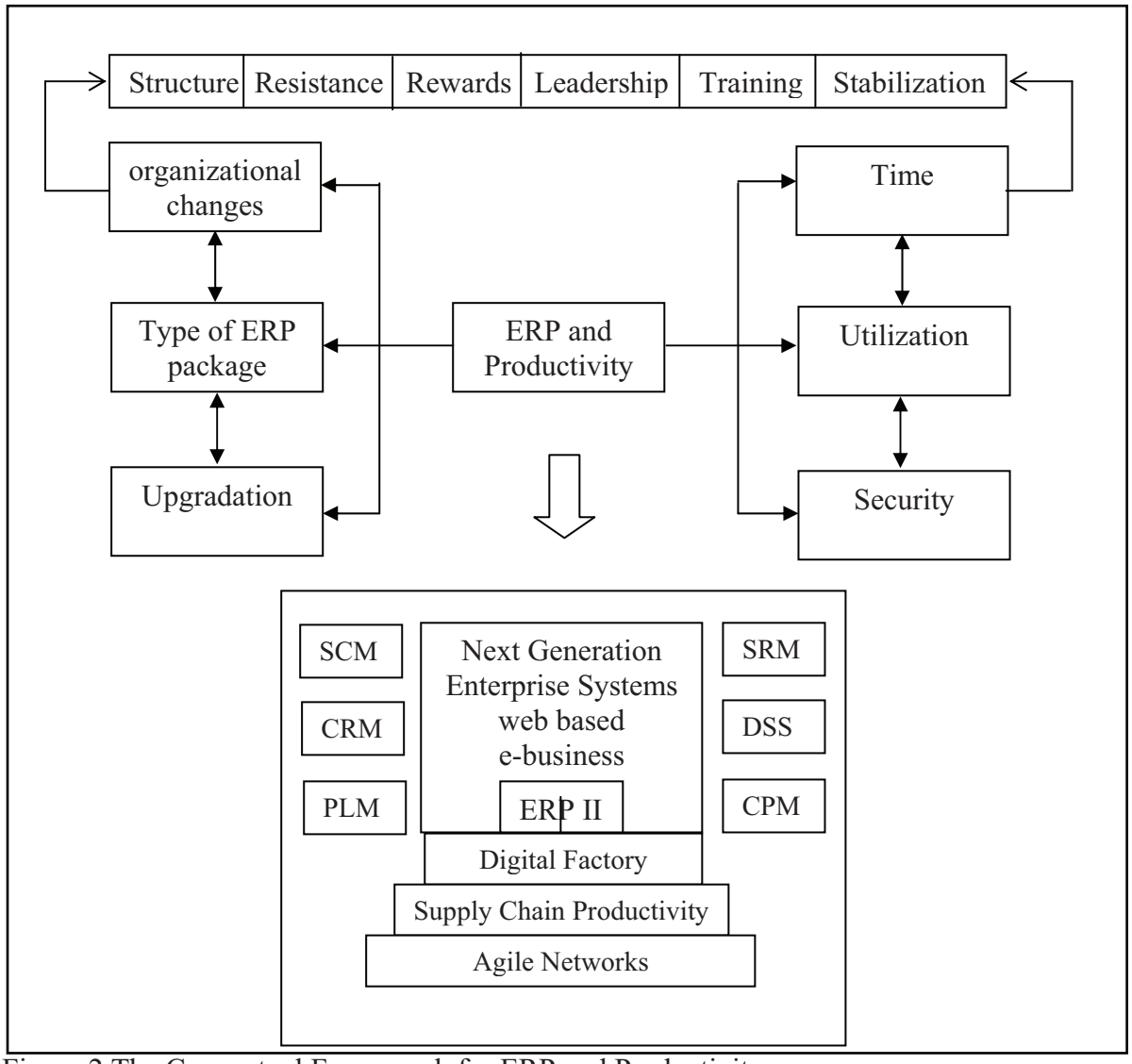

Figure 2 The Conceptual Framework for ERP and Productivity

The organizational changes that follow are closer to organizational restructuring dynamics as the evolutionary change alone becomes insufficient to achieve the ERP benefits (Gore, 2008). Evidence suggests that the ERP paybacks can be realized in a flat organization structure where qualified and empowered employees work with clear strategic objectives. However, the flat, responsive structure does not emerge radically and several transition forms appear instead to take a toll on the productivity. Hence, the management of resistance to change and transformation of reward schemes are the sub-factors in the conceptual framework.

ERP requires users to understand that they are no longer working in silos and this creates resistance due to fear of the unknown and inherent desire to maintain the status quo. This can be tackled by instituting new reward schemes that stress competence and superior performance, not just compliance. According to Bartol and Srivastava (2002), rewards are important for most mechanisms of knowledge sharing and could be made partly contingent on knowledge sharing behaviours as in merit pay, and team-based or company-wide incentives like profit sharing and employee stock options. Such reward schemes provide impetus for productivity growth after ERP implementation.

Platform	Components	Factors	Sub-factors
Foundation	Standard ERP Modules	Type of ERP Package Utilization Organizational Changes Upgradation Time Security	Structure Resistance Rewards Leadership Training Stabilization
Next Generation Enterprise Systems	SCM CRM PLM SRM DSS CPM	Digital Factory Supply Chain Agile Networks	Web based E-business

Table 1 The Platforms in ERP and Productivity Characterization

Time is another factor that has significant bearing on productivity through the sub-factors of stabilization and training. The companies typically require 12 to 36 months to stabilize before productivity can be recorded and ERP being not just software installation but solution for business, the implications could go well beyond the internal value chain processes and encompass the global activities thereby setting new trends in productivity attainment. The leadership has to be responsible for ERP so as to 'own' ERP from a strategic perspective and the top management commitment is imperative in order to take any real strides towards the objectives of the enterprise. In this regard, investment in training the people in ERP systems is foremost activity that is time-dependent and as Finney and Corbett (2007) note, training is the crucial part of ERP implementation or in effect the precursor for productivity. Further, stabilization involves resolving issues after the 'go-live' stage towards post-implementation aspects like upgradation.

Upgradation means to raise the ERP by newer versions or releases of application suites to expand the capabilities of the system and leverage the business value. It is essential to treat

upgradation like a new project since the efforts required depend on myriad of technical, organizational and operational matters. Organizations that underestimate the time and resources needed for upgradation commonly limit the planning time, rush to implement system changes and fail to thoroughly test all facets of the updated ERP environment, thereby causing disastrous impact on productivity (Beatty and Williams, 2006). Hence, upgradation is a key initiative that can be best conducted by the original ERP implementation team so as to reduce the overall cost and time. The users' understanding and 'buy-in' can only result in enhanced productivity.

Elements of Productivity in the Next Generation Enterprise Systems

The second platform comprises of factors that are associated with advanced enterprise systems in which the embedded components are devised to extend the standard ERP functions. The purpose here is to comprehend the productivity facets in the view of the fact that research is continuing in each of these specialized areas.
Once a company becomes a convert to the ERP philosophy, it starts looking ahead to the advent of e-commerce and extended ERP applications. The low cost and ease of use of internet has increased efforts to connect supply-and-demand chains across organizations (Davenport and Brooks, 2004). So, the next generation enterprise systems include supply chain planning, integrated e-commerce, decision support systems and customer relationship management (CRM). According to Møller (2005), ERP II is essentially web-based, componentized ERP, e-business and collaboration in the supply chain.

The SCM module enables planning, execution and coordination of the entire supply network in the changing competitive environment. Two key elements underpinning the success of the e-SCM are collaboration and visibility. All firms involved have to consider collaboration as a strategic asset and an operational priority in order to foster trust among trading partners and the information visibility across the supply chain has to be managed with strict policies, disciplines and monitoring (Búrca et al., 2005). Consequently, productivity needs to be highlighted as 'supply chain productivity' in the context of supply chain management. Supply chain managers then need to be responsible for earning power and productivity of assets in their trust, not just for cost control of these assets (Byrnes, 2005); therefore going beyond the traditional supply management, obligating the supply chain managers to arm with expertise in knowledge generation and change management. Differentiating the company from the competitors by using supply chain capabilities and focusing on return on invested capital (ROIC) management are positively linked to supply chain productivity. Initially, this ideology concentrated on the planning process only within the concept of digital factory. The digital factory is a comprehensive network of digital models, methods and tools – including simulation and virtual reality visualization – that are integrated by a continuous data management system with the purpose of having integrated planning, evaluation, and continuous improvement of all essential processes and resources of the factory in combination with the product (Bracht and Masurat, 2005). The concept essentially enlarged the ERP pitch that today encapsulates the absolute supply chain detail. Moreover, some vendors cater to specialized engineering organizations such as made-to-order or custom-engineering firms with unique supply chain need, to achieve higher productivity gains. However, Koh et al. (2006) contend that in these cases apart from ERP to manage the supply chain, other technologies such as radio frequency identification (RFID), wireless technology and intelligent knowledge-management systems would be more significant for efficient supply chain. Further, the components such as customer relationship management (CRM),

supplier relationship management (SRM), product lifecycle management (PLM), decision support systems (DSS) and corporate performance management (CPM), are productivity boosters. CRM promotes customer identification, interaction and service management thus providing a tool to improve productivity, satisfaction, delivery and decision-making, while SRM facilitates management of supplier relations in their complete life cycle. We appreciate these prevailing perspectives but concur with the school of thought that integration is the essence than just making the technology available for business. The rapid investment in ERP add-ons does not automatically ensure rapid labour productivity growth unless supported by intensive training and motivation. Hence, the research needs to be expanded particularly for architectures in agile networks wherein the entities could be opportunistic or proactively anticipating changes, and for productivity paradigms encompassing customers' operations as well.

CLOSING REMARKS

This paper attempts to establish a conceptual framework for ERP and productivity based on the analysis of ERP research and emerging enterprise system perspectives. The model compiled sets an outline of ERP and productivity characterization that has so far remained obscure in the literature or curtailed to general observations about the IT phenomenon. As the next generation enterprise systems are progressing rapidly, a host of new implications are emerging for productivity together with the challenges of inter-organizational integration. The paper provides insights for interesting future work on productivity in the scenario of digital factories and agile networks.

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ARE WEB BASED LEARNING MANAGEMENT SYSTEMS SUSTAINABLE OR DISRUPTIVE?

Dr. Bala Maniam, Sam Houston State University,USA
maniam@shsu.edu
Christina Cross, Sam Houston State University,USA
gba_bxm@shsu.edu

ABSTRACT

A sustainable technology is one that is arrived at through incremental improvements to an existing technology. These products are usually higher quality due to the continuous testing and improvements. An example would be in the camera industry. Leading companies focused on improving the quality of film cameras and offering new features on these cameras that appealed to their core customers. A disruptive technology, however, is a new innovation that does not follow the guidelines of sustainable improvement, but jumps over the current technologies to appeal to fringe customers. This product is in lower quality, but it offers some benefit that can't be found in existing technologies such as cost or convenience that causes some to adopt it. When digital cameras first emerged, their quality was much lower than comparably priced film based cameras. Many in the camera industry did not embrace this new technology because it only appealed to a few customers on the fringe. As customers began to embrace the digital technology, the quality quickly improved and has since dominated the market. Leaders in the industry did not allocate the resources to fully implement the new technology or they disregard it completely because they believed it was substandard and would not last. Still others were willing to give up the customers on the fringe and market to their mainstream customers. Sometimes industries are correct in their beliefs, but sometimes a new technology will begin to improve in quality and will be quickly adopted by mainstream customers. Web based learning management systems appear to have the characteristics of both of these models. (Armstrong, 2000)

Web based learning management systems (LMS's) have enabled many nontraditional students who would not otherwise be able to take classes to further their education. LMS's bridge the gap of both time and space and enable institutions to offer courses that meet the needs of students who are not able to attend face to face classes due to either their proximity to the institution or scheduling conflicts. Offering these opportunities helps institutions reach out to students, for example an adult student may work full time and find it difficult to commute to campus each week. An online course offers them a viable alternative. LMS's also offer the institution alternatives in scheduling. An institution can create economies of scale by offering a hybrid course which is partially online and partially face to face which allows them to schedule two classes in the same time slot.

Offering online courses also brings up additional issues that need to be addressed. A distance learning program needs to be thoughtfully planned out in order to avoid the two extremes of canned courses or courses independently created by faculty who are not experienced in online teaching. Canned courses can lead to an impersonal experience for students; while a

poorly designed course can lead to confusion and frustration. Frustrated students can lead to low retention levels and can stifle a distance learning program's growth.

Web based LMS's have pushed distance learning into exponential growth. Not only had distance education become more mainstream, it is being offered and strongly advertized by higher education institutions for both undergraduate and graduate programs. Web based learning has changed the face of education in that universities now have to compete with other institutions who offer the convenience of a degree that can be obtained completely online. With technology becoming more and more engrained in our lives, students will need to learn this technology in order to become functional in the workplace. Educators are now responsible for preparing students for a career in which they will be expected to use technology that may not even exist today.

This paper will discuss whether web based learning management systems are a disruptive or sustainable technology in the higher education industry. It will first address the evolution of modern distance education from the traditional correspondence type course to modern web based distance courses. It will then discuss how communication and social presence are improving online distance courses and creating a sustainable advantage. Next it will outline new roles for teachers and students in an online environment and the responsibilities that are placed on an administration when adopting an online learning program. Finally, the paper will discuss quality and improvements in online education and conclude.

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Unleash Corporate Capability of Knowledge Management with Web 2.0

Shu-Fang Lin, Department of Business and Administration, Yuanpei University,Taiwan.
Lucy_linn@yahoo.com

ABSTRACT

The latest pervasion of Web 2.0 has created more than technical impact to individuals and organizations alike, rather, it has profoundly influenced the way we communicate, learn, work, and live our lives. A surge of growth in adopting Web 2.0 application into the business processes has been witnessed around the globe, and the trend is still on the rise. In knowledge management arena, new space and potentiality for innovation in business process are widened through various forms of Web 2.0 applications. However, due to strategic, managerial and technical reasons, the implementation of Web2.0 application into the organizational learning practice is an area too new to be mature. The situation is even more prominent in Taiwan, where innovation is one of the top concerns for organizations to sustain their competitive advantages.

The present research proposal is aimed at investigating the impact and influence of Web2.0 over the practise of knowledge management, and how can organizations unleash their collective intelligence and gain competitive advantages through leveraging web 2.0 capabilities. Attempts are also made to identify the various reasons behind the resistance of Web2.0 adoption in their knowledge management system. Eight hypotheses are developed to address the issues arising from both the literature and organizational practices, respectively from a strategic, managerial, and technical perspective.

Using case study approach, this research work is to conduct qualitative analysis based on both personal and organization experience of knowledge management facilitated by Web 2.0.

Keywords: web 2.0, organizational learning, SECI, knowledge management

INTRODUCTION

The evolvement in web technologies has been shaping the fashion we communicate, the notion of our society, and ultimately, the way we live our lives. In knowledge management arena, new business paradigms has offered enormous competitive

advantage to those who embrace the new tools that enable contextual, agile and simplified information exchange and collaboration to distributed workforces and networks of partners and customers. The social software technologies emerging through computerization will solidify the web not only as a new business platform, but also as a rich learning, knowledge creation and collaboration environment. With the advent of the Web 2.0 technologies, web-based learning is shifting to new learning community driven requirements, which facilitates novel approaches for flexible, evolving, adaptable, and interoperable community (Spaniol et al, 2008).

With respect to knowledge creation and management, the SECI model developed by Nonaka and Takeuchi has come to be the most widely recognized and accepted all over the world. The SECI model consists of three elements: SECI, ba, and knowledge assets, which interact with each other organically and dynamically. According to the SECI model, organizational learning is mainly a social process and Japanese companies are more competitive because of their collaborate culture. Featuring sharing, community based collaboration, user-generated contents, collective intelligence, Web 2.0 concepts seem to be an ideal fit with Nonaka's SECI approach for more personal, dynamic, and social learning on a global scale. As asserted by Chatti et al (2007), web 2.0 can drive SECI model based learning process. Spaniol et al (2008) argued that Web 2.0 can be used for folksonomy, syndication, participation, knowledge sharing and control.

However, most IT departments today have resisted Web 2.0 tools due to various strategic, managerial and technological reasons. Likewise, the impact and influence of Web2.0 over the practise of knowledge management, and how can organizations unleash their collective intelligence and gain competitive advantages through leveraging web 2.0 capabilities is still under researched. The present research plan is aimed at investigating the impact and influence of Web 2.0 over knowledge management, and attempts are made to provide a framework model for organizations to incorporate web2.0 into their knowledge management practices. The study will base its theoretical foundation on the analysis of case studies. Group discussions and seminars will be held to develop the hypotheses, and questionnaires will be used to collect data and testify the hypotheses.

LITERATURE REVIEW

Web 2.0

Web 2.0 can be described as the "intelligent web" or "harnessing collective intelligence". It refers to a set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet—a more mature, distinctive medium characterized by user participation, openness, and network effects (.O'Reilly, 2005).Through a variety of tools, like blog, wiki, podcasting, rss, sns, and etc, Web 2.0 incorporates a two-way and interactive mechanism to enable individuals contribute to the development and distribution of tools, contents, and software applications over the Internet. In other words, the core values of Web 2.0 include four characteristics: unconstraint, service, externality and user-centered. Dron (2007) points out that the characteristics of Web 2.0 can be explored from several aspects, as follows:

- **Social software and control**
  organic and self-organizing, underpinned by dynamics that parallel natural processes.
- **Contribution**
  Each Internet user has the opportunity to actively provide their knowledge content to the shared domains.
- **Sharing**
  knowledge contents are freely available to others, but secured mechanisms may be enforced to enable the knowledge sharing among legitimate members within specific communities.
- **Collaboration**
  knowledge contents are created and maintained collaboratively by Internet users, who participating in the knowledge contents can have conversations as a kind of social interaction.
- **Dynamic**
  knowledge contents are updated constantly to reflect the changing environment and situation.
- **Reliance**
  knowledge contribution should be based on trust between knowledge providers and domain experts.

Spaniol et al. (2008) identify seven Web 2.0 business-models (peer pioneers,

ideograms, presumes, new Alexandrians, platforms for participation, global plant floor, wiki workplace) that could be used to enhance organization knowledge management. According to Lin (2006), the key success factors of Web 2.0 are content, community, consumer experience, and cross service integration. Abram (2006) notes that the success of Web2.0 should be attributed to the critical feature of interactivity in Web 2.0.

Successful examples of Web 2.0 application include Wikipedia, Blogs, BitTorrent, Google adSense, ebay Reputation, Amazon reviews, Gmail, Google Docs, Goodle Calendar, Google maps, and the list can go on and on.

Web 2.0 and Knowledge Management

Before defining the concept of knowledge management, it is important to define knowledge. Many researchers have defined knowledge from different perspectives. Some define knowledge as experience, concepts, values or beliefs that advances individual's ability to take effective action (Alavi and Leidner, 2005). Others treats knowledge as fact of knowing, an object, as a process, or a capability for action. (Zack, 1999).

Knowledge management is managing the knowledge through a systemic and organizational specified process for acquiring, organizing, sustaining, applying, sharing, and renewing both tacit and explicit knowledge by employees to enhance the organizational performance and create value (Davenport, 2001). Nonaka et al. (1995) identify four steps of knowledge creation processes including: socialization, externalization, combination and internalization (SECI).

- **Socialization** is a process of sharing experiences and then creating tacit knowledge through communication.
- **Externalization** is a process of articulating tacit knowledge into explicit concepts.
- **Combination** is a process of systemizing concepts into a knowledge system through combination of various components of explicit knowledge.
- **Internalization** is a process of embodying explicit knowledge into tacit knowledge for becoming valuable assets.

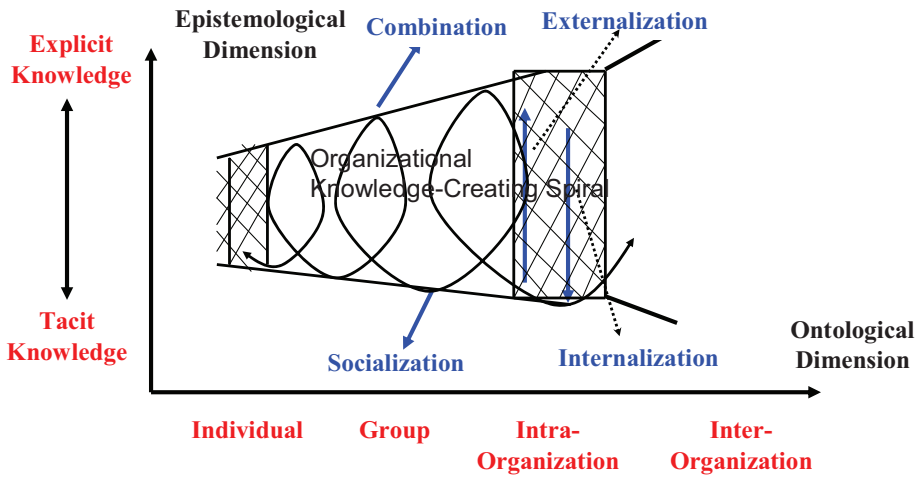

Figure 1 Organizational knowledge-creating spiral by Nonaka and Takeuchi (1995)

The basis of this model is a distinction between two types of human knowledge: explicit and tacit. Explicit knowledge or information is codified, objective knowledge that can be transmitted in formal, systematic language. In contrast, tacit knowledge is not easily codified, difficult to express and subjective. A spiral emerges when the interaction between tacit and explicit knowledge is elevated dynamically from a lower ontological level to higher levels. In short, knowledge can be generated by identifying what knowledge exist in the organization or collecting and importing knowledge from outside or learning from existing knowledge. However, the generation of knowledge to the Web 2.0 can be affected by the individual's perception of usefulness of the Web 2.0 content, as claimed by the technology acceptance model (Davis et al., 1989).

Web 2.0 as a tool appeared in many different forms such as wikis, blogs, social-networking, open-source, open-content, file-sharing, peer-production, and etc. Its application has also gained scientific attention in the area of knowledge management, as Web 2.0 acts as a platform for knowledge creation, knowledge sharing and knowledge utilization. The success factors of Web 2.0 for knowledge creation are built upon the strong emphasis on knowledge networking and community building to leverage, sustain, and share knowledge in a collaborative way (O'Railey, 2005). In other words, the community building enables individuals to share a common language and would be more at ease discussing ideas openly and challenging the ideas of others. Hayduk (1998) also observes that learning are more effectives when knowledge is shared among a self-selected peer group. Though shared knowledge creation space is an important catalyst for knowledge creation, some argue that close tie in a community limit knowledge creation because individuals are unlikely to

encounter new ideas in close-knit networks where they tend to possess similar information (Robertson et al., 1996). Spaniol et al. (2008) also indentify that the use of Web 2.0 as a platform for knowledge creation can result in folksonomies. Users can recognize the use of Web 2.0 as social classification and social tagging, and therefore it is to annotate and categorize the content of knowledge created.

Don (2007) claims that the mass collaboration in Web 2.0 enables organizations to make profits, but the effectiveness of profit generation of the Web2.0 depends on the interactivity among users. Web 2.0 is all about flexible and simple implementations that populate by usage and gain momentum from day one. Highly visible, highly useable and without the complexity that becomes a barrier to use. For some companies that use of wikis, they are becoming so pervasive that they're rivaling traditional knowledge management tools at a lower cost. For example, Web 2.0 is internal wikis that create a place for global employees to collaborate and brainstorm. It's blogs that allow a software development team to stay informed without multiple e-mail threads and attachments. And it's a website that harnesses customers' opinions for improved products and sales.

However, sharing knowledge are often unnatural acts (Davenport,2001; Hendriks, 1999; Wasko and Faraj, 2005; Hars and Ou, 2002). If knowledge is a valuable resource, why should it be shared? If one’s job is to create knowledge, why should he put his job at risk by using his own instead of that of the others? To enter our knowledge into a system and to seek out knowledge from others is not only threatening, but also just plain effort so we have to be highly motivated to undertake such work. If the knowledge manager adopted this principle, we wouldn't take sharing and use of knowledge for granted. Therefore, we wouldn't assume that the deployment of a web 2.0 system will lead to widespread sharing, or that making information available will necessarily lead to its use. We would realize that sharing and usage have to be motivated through time-honored techniques performance evaluation, compensation, for example. Thus, this study proposes that:

With the enabler of Web 2.0, it can be seen that shared ideas and information will be increased rapidly. The integration and capturing of knowledge will the challenge for organizations. Therefore, the ability to integrate and apply specialized knowledge by organization members is fundamental to a firm in creating and sustaining a competitive advantage (Davenport, 2001). Chatti and at al (2007) also point out that organizations have to place attention on knowledge transfer over issues of networking

and collaboration and intelligence search to be benefit from the Web 2.0 technologies.

Social media support a bottom-up building of communities and networks. Effective knowledge management practices need to take a personal, open, and knowledge-pull approach based on small, loosely joined pieces. The main obstacle of the knowledge-pull model lies in the information overflow on the Web. Therefore, we need intelligent search mechanisms for reliable access to information, services, communities, and expertise. Alavi and Leinder (2005) note that the extent to which knowledge should be transferred or can be transferred depends on the interdependency among individuals or communities. If knowledge does not become integrated in the organization, the organizational knowledge transfer will not succeed and lots of resources are in fact wasted. It is important to know the way in which interactivity affect knowledge transfer in an organization.

Web 2.0 challenges the core assumptions about information in the corporation—who gets it, who owns it, and who has power because they have it. And that's a really scary thing for people used to controlling it. These fears help explain why Web 2.0 hasn't quite caught on with the corporate crowd (Daniel, 2007). Enterprises are embracing Web 2.0 as a critical business tool that enables them to share information, create communities and user networks, and glean referrals that build loyalty by showing expertise and responsiveness to their most important asset: their customers. Web 2.0 tools have gained critical mass in the mainstream and even across age ranges, according to a study by Booz Allen released in January 2007 which interviewed a sample of 2600 persons, 42 percent of MySpace users and 41 percent of YouTube users are over the age of 35. Web 2.0 seems to cut across age and gender and—more importantly to businesses—it influences purchase decisions. The study's conclusion: "The need to evolve existing business models by integrating the Web 2.0 environment is urgent."

Also, it is important to note that while there can be enormous business benefits to leveraging Web 2.0, it also imposes unprecedented levels of security risks.

A white paper by websense corporation (2005) discussed in length of these potential risks in the deployment of Web 2.0, such as inappropriate content or applications finding their way on to company computers; the increased possibility of viruses, worms, and malware; and accidental or malicious data loss. More remarkably, it breaks down many of the legacy models around which IT security has been built.

These traditional approaches include securing the perimeter, reactive threat protection, and reputation analysis. Alavi and Leinder (2005) point out that organizational culture has been identified as catalyst or a major hindrance to knowledge creation and knowledge sharing. With the potential risk of Web 2.0 technologies might brining, the organization initiatives to the use of Web 2.0 for knowledge management is crucial.

Based on the literature review and our preliminary studies, we form eight hypotheses, each of which is centered a specific type of influences that web2.0 applications are bringing about to the practice of knowledge management, respectively from strategic, managerial and technical perspectives, as depicted in Figure 2.

From the strategic level, we propose that:

H1: Perceived value of Web 2.0 by the management affects the knowledge management strategy in the organization.

H2: Organization culture is decisive to Web2.0 implementation for knowledge management.

From the managerial perceptive, we propose that:

H3. Management capability of integration will affect the effectiveness of the use of Web 2.0 in knowledge management practices.

H4: Web2.0 KM practices shall be incorporated into the routine processes of business operation.

H5: A reward system which motivates user participation has a significant influence on knowledge sharing and utilization.

Finally, in the technology dimension, the enabling technologies of Web 2.0 applications lay the very foundation of knowledge management platform, we therefore propose that:

H6: Selection of technology affects the effectiveness of knowledge management, as well as the system security.

H7: User-centered experience is critical in enhancing user participation.

H8: Both strong-tie communities and weak-tie communities are important on knowledge creation and sharing.

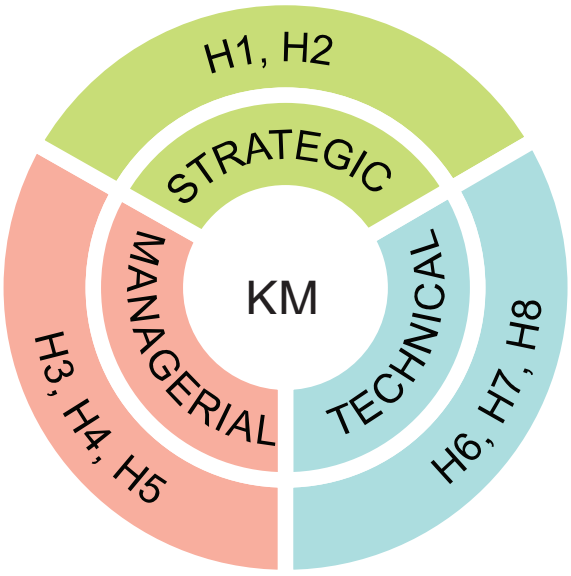

Figure 2 Research model for knowledge management with Web 2.0 technology

Research Method

This study will employ a case study approach, which is the preferable method for analysis in early stage of research on a topic when a fresh perspective is needed (Yin, 1994). Though qualitative approach has been criticized for being less generalizable, qualitative approach can yield thick and rich descriptions of actual events in real-life contexts which uncover and preserve the meanings that those involved ascribe to them (Gephart, 2004). In order to reach the rigor of qualitative approach, this study will also employ a personal case study research design, which aims to provide user point of view on the use of Web 2.0 tools for personal knowledge creation, knowledge sharing and knowledge generation purposes. A personal case study refers to a researcher uses a set of actions to improve the efficiency in certain activities related to the project. In addition, an industrial case study on the influence of application of Web 2.0 technology on organization's knowledge management will be conducted to examine the proposed research hypotheses.

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Leadership and Organizational Learning as Antecedents to Knowledge Management Practices

Sanjay Kumar Singh, Institute of Management Technology, India
sanjaysinghdu@yahoo.com

ABSTRACT

The management of knowledge in organizations belonging to different industry segments across the geographic boundary of the nation has become an ultimate business reality. The firms which swear by it have been found to compete effectively even in the volatile business environment. The empirical studies of these firms by the management thinkers have found organizational level variables along with personal and interpersonal level variables of the employees to create significant impact on to the knowledge management processes of the firms which if leveraged results into sound organizational health. This study is an attempt to find out potent organizational level variable(s) affecting the knowledge management processes and also to design a framework to be used by the firms operating in different businesses throughout the globe. The meta-analysis of the findings of several empirical studies, which were conducted by the researchers in different cultural settings, provides an interesting insight in this direction. The author observes that the leadership of the firm along with rigorous practices of the organizational learning mechanisms results into creating as well as management of the knowledge for the competitive advantages of the firms. The observation of the present study was also used to develop a framework of the knowledge management practices but it needs to be validated by the management thinkers and practitioners who have been working in this domain of knowledge. It is hoped that this simplistic framework of knowledge management will lead the firm towards successes.

Key words: *Leadership, organizational learning, knowledge management*

INTRODUCTION

The financial meltdown which the world witnessed in the second half of 2008 has sent deep seated message to the captains of the industry across different parts of the world to compete through management of knowledge. The art and science of knowledge management which is the urgent need of the day depends upon learning on the part of the members to reach at organizational level and this to get significant boost by practicing a significantly different leadership styles. The studies have been carried out intensively in each of the three areas separately but no serious attempt has been made to bring them together on a single platform for business excellence. This inquiry is a conceptual level effort in that direction and believed that it will be of importance to the organizations which have been facing the heat of world's worst financial crisis. It is said that the present financial meltdown and its impact can be successfully attended to by increasing the understanding of different aspects of globalization and interrelationships of various factors and their changes will help organizations to meet the new challenges brought by globalization, whether their primary operation environment is domestic, international, or global (Jokinen, 2005). Moreover, the effect of globalization has been such that

the operating environment of the business which used to reside well within the geographic boundary of the nation up to 1990s has gone away and as a result organizational mindset is of working locally but thinking globally.

The present world scenario makes it imperative to develop global competencies for persons especially in leadership roles in the corporations. McCall and Hollenback (2002) believe that these global competencies should be based on to the global business strategy which to determine what kind of global presence is desirable, how many and what types of international or global jobs, projects, task forces, and other types of interactions exist. It is such that what happens in the small city of the USA, it impacts immediately and significantly to the life of businesses in the Indian subcontinent as well. In other words, these developments suggest that now the context of the business has gone for a sea change and this calls for a fresh look on to the part of the captain of industry to think of global leadership competencies. It is these global leadership competencies which will remain now onward as only competitive advantages for any corporations anywhere. Zahra (1999) says that tomorrow's global marketplace will reward companies which will value entrepreneurial risk taking, invest heavily in developing intellectual capital, promote individual growth, and adopt policies that are environmentally friendly. Hence, to do these arduous jobs of global corporations, the successful competitiveness in 21st century will demand the use of visionary and dedicated leadership.

Organizational Leadership for Learning Organizations:

The construct of Leadership is defined by knowledge, skills, and abilities, rather than by position or title. The core competencies of leadership can be learned, and the learning is a life-long process. It is purely a process by which a person influences others to accomplish an objective and directs the organization in a way that makes it more cohesive and coherent. The leaders carry out this process by applying their leadership attributes, such as beliefs, values, ethics, character, knowledge and skills. Today, CEOs are under constant pressure to find new sources of growth in an increasingly demanding and competitive business environment. Senge (2000) enunciates three core characteristics for a person to be in a leadership role in present day organizations and they are of an architect, a teacher, and a steward. These three qualities helps in clarifying mission, vision and values; specifying strategies, structure and politics; creating efficient learning processes; and helping subordinate continually develop their mental model and system thinking.
The today's CEOs must learn to inspire their organizations to new levels of inventiveness in everything that they do, not just in marketing or new product development (Leavy, 2005). Therefore, it calls for a new kind of leadership role and thinking whereby all the stakeholders are internally energized for continuous renewal in people, processes, and product. Survival and growth of organizations are based on a dramatic shift in leadership. It is no longer the time of a heroic leader – the leader walks in and takes up all the space in the board room. Instead, the job of today's leader is to create space for other people to generate new and different ideas; to encourage meaningful conversation between people: and to assist people in becoming more effective, agile, and prepared to respond to complex challenges (Martin, 2007).

Contemporary organizations in India face continuous challenge for successfully translating quality improvements into sustainable competitive edge. Like people, organization should learn

in order to adapt itself successfully to the ever changing business reality. Therefore, Lietaer (2002) has rightly said that a critical success factor for a firm in the knowledge economy for any kind of competitive advantage is that it should possess ability to learn and exploit its existing knowledge base. Shukla (1997) emphasizes to the importance of organizational learning (OL) in Indian firms surrounded with qualitatively changed business environment due to globalization of Indian economy. In Indian organizations, knowledge about customers is given the most importance and firms put serious effort in identifying the most crucial knowledge and then leveraging it for sustainable competitive advantage (Pillania, 2007). To put it in a more explicit way, it is noted that learning enables an organization to continually expand its "capacity to create its future" (Senge, 1990).

The academicians as well as the practitioners have been constantly engaged in researching about global leadership competencies for the business organizations in the 21st century. It is simply because there is increasing business need for global leaders has been felt but still what specific competencies are required to be a global leader have not been explicitly identified (Morrison, 2000). It has been observed that excellent domestic leaders often have the same qualities as global ones, but that excellent global leaders retain these capabilities even in completely unfamiliar situations (Kets de Vries and Florent-Treacy, 2002). Such an observation made by Kets de Vries and Florent-Treacy (2002) suggest to the author(s) that people with global leadership attributes depict more of the qualities of an emotionally intelligent leaders who remain cool and composed even in tiring situations and deliver to the expectations of all concerned. Boyatzis et al. (1999) contends that emotional competencies such as self-awareness, self-management, social awareness, and relationship management are demonstrated by a person whenever she/he interacts with the world around. Success in the global environment requires more than just knowing about different cultural norms and management theories, but it is putting this knowledge into leadership practice (Carey et al., 2004). McCall and Hollenback (2002) observe that the global executives need to learn how to work cross-culture and it is for the most people an emotional education as well as an intellectual one. The challenges of global work arise in three areas: distance, country, and culture. When the world becomes smaller and the workforce becoming more diverse; the key challenge for leaders is to effectively lead across cultural borders (Dalton, 2003).

The literature reveals that transactional leadership was largely studied until 1970s which believe in reciprocity that the relationships between a leader and followers is based on the exchange of some form of reward. At the same time, it is to mention that the research literatures in the late 1970s and onward started talking of a new kind of paradigm to be referred to as transformational leadership. Here, leadership is perceived as engaging the hearts and minds of others around for getting the work done in more effective way (Burns, 1978). But it is also to state that transactional and transformational leadership do not exclude each other, as a leader can be both (Bass, 1985). The research literatures indicate transformational as well as transactional forms of leadership to be positively associated with processes of organizational learning. Lam (2002) and Sadler (2001) in their studies found transformational leadership to have significantly positive effect on encouraging and emphasizing teamwork spirits and involvement at workplace. Similarly, Bass (1997) and Bass and Avolio (1990) also found in their studies that transactional leadership significantly helps improve the efficiency of organizational learning. Therefore, it

may be deduced that both transformational as well as transactional form of leadership have significantly positive effect on the functioning of learning organization.

The literatures which mention the general beliefs of 1980s and 1990s that organizations need only one knowledge leaders to make the process work is erroneous in the context of present days global world order. On the contrary, the knowledge leadership should be evident throughout the organization and it should operate at a range of levels. The effective organizations rely on leadership than leaders (Hubbard et al., 2002). The role of knowledge leader is to provide strategic visions, motivate others, effectively communicate, act as a change agent, coach others around, model good practices, and carry out the knowledge agenda (Debowski, 2006). The knowledge leaders need to explain the goals of knowledge management so that people can identify their roles in achieving those goals. They need to provide guidance on any changes in processes and priorities needed to reach those goals (Debowski, 2006).

Hubbard et al. (2002) is of the opinion that knowledge leadership, apart from having ability to establish predictable and stable processes, needs to encourage innovation and creativity to responding to opportunities. Therefore, the knowledge leaders must have a good understanding of people, processes, systems and business principles which shape business decisions (Debowski, 2006). The knowledge leader's strategic leadership operates from an understanding of the core business and how it relates to the values of that organization (Maurik, 1999). Therefore, the visionary leadership needs to operate at two levels: tactical and futuristic (Kouzes and Posner, 2002). The enthusiasm, drive, and energy of the knowledge leader play a major role in building a commitment of others. Goleman et al. (2002) also notes that visionary leadership has a strong positive effect on organizational climates, and is particularly important when a clear direction is needed. Hence, the nature of the knowledge management development requires continual support by leaders to ensure that the value and outcomes of knowledge management are held firm in contributors' minds.

Learning organizations: The need of the time

Organizational learning as a concept came to academic literature for the first time when March and Simon (1958) were involved in their pioneering work on understanding the complexities of organizations. Since then many authors have contributed significantly to the growth of this body of knowledge though the road to acceptance has not been a straight one. Unfortunately, both the definition and use of the term organizational learning are still associated with considerable confusion (Edmondson and Moingeon, 1998; Easterby-Smith et al., 1998). Furthermore, the scholars have frequently associated the facilitation of organizational learning with the learning organization (Easterby-Smith et al., 1998). Throughout the 80s and the 90s, organizational learning achieved prominence amongst the ideas influencing management studies. The topic has attracted increasing attention, both in academic circles (Shrivastava, 1983; Levitt and March, 1988) and in business practice (Senge, 1990; Argyris, 1993). One of the main reasons for this is the increasing pressure of change on organizations.

Organizational learning may be considered as long-term activities that build competitive advantages over time and requires sustained management attention, commitment, and effort. In

other words, the role of leadership is prerogative for building a learning organization. A learning organization is an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights (Garvin, 1993). Organizational learning has also been viewed as a process through which an organization continuously acquires new knowledge and adjusts itself to successfully adapt to internal and external environmental changes and to maintain sustainable existence and development (Chen, 2005). To achieve all these important competencies, Garvin (1993) believes that it is time to move away from high aspirations and mystical advices which are being given to managers and move on to clearer guidelines for practices and operational excellence. Such a scenario has had been in place for successful learning organizations like Honda, Corning, and GE which have effectively managed their learning capabilities in such a way to ensure that it occurs by design rather than by chance. Moreover, leading learning organizations also have employees training which have especially been designed for developing/sharpening behavioral skills than technical skills that have a short shelf-life (Kiernan, 1993). The prime example of such an organizational attitude can be noticed at Xerox Company. It has implemented a group training program for all its employees at all levels which has been named as *'Leadership through Quality'* that focuses on how to work in teams and in problem-solving processes (Goh, 1998).

Moreover, there seems to be apparent difficulties with the notion of organization learning as a whole. There is clear evidence that learning does take place in organizations during dynamic interactions amongst individuals, groups, and the organization itself (Akgun et al., 2003; Chan, 2003). The benefits of organizational learning are well recognized in terms of improved innovation (Chanal, 2004), achieving and sustaining change (Boyce, 2003), and in developing competence (Pedler, 2002). For long-term success, organizations should be able to learn continuously, to leverage from the knowledge they capture, to apply it to reality and to increase innovative knowledge (Liedtka, 1999) for competitive advantages. The process of effective organizational learning, by way of sharing information and knowledge among organizational members, enables individuals and organizations to reflect on the consequences of their behaviors and actions, to obtain insights from an environment where they operate, to understand the environment, and hence to interpret the meaning and react to it in more accurate approaches (Jones et al., 2003).

In the new economy, organizations may face learning overload; thus improving organizational learning capability is critical for competitive advantage (Goh, 2003). A strategic learning capability involves "strategically figuring out what an organization needs to know and then taking action to acquire that knowledge (DiBella, 2001). The relationship between organizational learning (OL) and knowledge management (KM) has been best put forward by Garvin (2003) when he says that an organization that learns is an expert organization in creating, acquiring and transmitting knowledge, and modifying its behavior to self-adapt. Organization which learns is expert in five activities: systematic resolution of problems, experimentation of new focuses, use of their own experience and past in order to learn, learning from the experiences and more appropriate practices of other companies (benchmarking), and transmitting the knowledge to the whole organizational quickly and efficiently (Garvin, 2003). In this context, it is pertinent to say that the kind of economy that India is today requires firms to continuously get into the organizational learning mode.

Leadership for smart companies:

The literatures have also found evidence for role of leadership in making an organization a truly learning company. In other words, the smart organization is credited to possess a significantly different leadership style practiced for achieving the set goals. In these organizations, the main task of leaders is to encourage knowledge sharing, supporting learning through mistakes, and creating continuous team learning (Macneil, 2001). Popper and Lipshitz (2000) emphasize that leader can create organizational structure and shape up organizational culture to result in influence through various affairs, actions, and service; thus leadership to actually affect organizational learning. Leadership has also been found to improve the process and the result of organizational learning activities (Lam, 2002). The research literatures indicate transformational as well as transactional forms of leadership to be positively associated with processes of organizational learning. Lam (2002) and Sadler (2001) in their studies found transformational leadership to have significantly positive effect on encouraging and emphasizing teamwork spirits and involvement at workplace. Similarly, Bass (1997) and Bass and Avolio (1990) also found in their studies that transactional leadership significantly helps improve the efficiency of organizational learning. Therefore, it may be deduced that both transformational as well as transactional form of leadership have significantly positive effect on the functioning of learning organization. Leaders are needed to empower all the members of the learning organization by developing a shared vision, providing resources, delegating authority, celebrating successes, and most importantly, by being learning architect (Hitt, 1995).

Organizational learning and knowledge management: Empirical findings

Davenport (1999) also believes this to be the case and maintains that KM is gradually expanding in scope, consuming not only learning organization (LO) but also other emerging concepts such as business and customer intelligence. Spinello (2000) argues that organizational learning and knowledge sharing are intimately connected with each other. The knowing process is composed of sharing, thinking and learning components that have a reciprocity relationship. Knowledge sharing enables managers to keep the individual learning flowing throughout the company and to integrate it for practical applications. Though in a study by Swan et al. (1999), it has been found that there is an apparent decline in interest in the concept of learning organization since 1995 and has been offset by a sharp increase in enquires into KM. Pemberton and Stonehouse (2000) believe that successful learning organizations create an organizational environment that combines organizational learning with knowledge management.

Organizational learning which is also known as generative learning (Senge, 1990) is necessary especially for organizations that are operating in a highly dynamic environment where the rate of knowledge obsolescence is far greater (Wijnhoven, 2001). Organizational learning which results into organizational knowledge is much talked about but little understood (Tsoukas and Vladimirou, 2001). Therefore, thinkers like DiBella (2001) feels that there is a need to “bridge the divide” between knowledge management (KM) and organizational learning (OL). This study is an attempt in that direction to empirically investigate relationships as well as impact of organizational learning on to knowledge management in Indian software firm. A knowledge

management company moves from single-loop learning into what is known as double-loop learning. Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies, and objectives (Smith, 2002).

Understanding knowledge management as a practice:

Knowledge seems invisible, but it clearly drives the bottom line (Pascarella, 1997). The value of knowledge is increased when it has a key purpose and focuses on mission, core values and strategic priorities. Knowledge assets, like money or equipment, exist and are worth cultivating only in the context of the strategy used to apply them (Stewart, 1997). Knowledge management is a formal, directed process of determining what information a company has that could benefit others and then devising ways to making it easily available (Liss, 1999). Therefore, the steps in this process include how knowledge is captured, evaluated, cleansed, stored, provided, and used (Chait, 1998). It is unfortunate that very few organizations handles explicit and tacit knowledge effectively for business excellence. Exceptions are learning organizations that are skilled at creating, acquiring and transferring knowledge and at modifying their behavior to reflect new knowledge and insights (Garvin, 1993).

Knowledge management is a process that facilitates knowledge sharing and exchange and establishes learning as continuous process within an organization. Therefore, knowledge management and learning go hand in hand (Lopez et al., 2004). Davenport et al. (1998) defines knowledge management as a process of collection, distribution, and efficient use of the knowledge resource. O'Dell and Grayson (1998) believe knowledge management as a strategy to be developed in a firm to ensure that knowledge reaches the right people at the right time, and that those people share and use the information to improve the organization's functioning. Similarly, Bounfour (2003) defines knowledge management as a set of procedures, infrastructures, technical and managerial tools, designed toward creating, sharing and leveraging information and knowledge within and around organizations.

The literatures have also looked into different forms of knowledge and their leverage for organizational competitive advantage. The knowledge that organizational members have can be broadly categorized into two parts as explicit as well as tacit knowledge and both of them work interdependently and in turn leading organization to the path of successes. Explicit knowledge has been found to be increasing being used as well as emphasized in both practice and literature, as a management tool to be exploited for the manipulation of organizational knowledge. For Scarborough et al. (1999), groupware, intranets, list servers, knowledge repositories, database management and knowledge action networks allow the sharing of organizational knowledge. Similarly, Pan and Scarborough (1999) believe that explicit part of knowledge is systematic and easy to communicate in the form of hard data or codified procedures. In other words, explicit kind of knowledge can be transmitted across individuals formally and easily. On the other hand, tacit form of knowledge is subconsciously understood or applied, difficult to articulate, developed through direct action and experience, and shared through conversation, story-telling, etc. Blumentitt and Johnston (1999) contend that information can be captured and stored in

digital form whereas tacit knowledge repositories reside only in intelligent systems, which are within individuals. Tacit knowledge needs to be considered as "knowledge-in-action" which presumes that this is knowledge that has not been articulated as opposed to explicit knowledge that is readily accessible within the organizational domain (Platts and Yeung, 2000).

On the other hand, the management thinkers and practitioners have also made several attempts to define knowledge by distinguishing between data, information and knowledge (Wiig, 1993). The literature is full of various classifications of knowledge the most widely discussed and quoted among them are the ones developed by Wiig (1993), Nonaka (1994), Edvinsson and Sullivan (1996), Carayannis (1999) and Despres and Chauvel (2000).

Wigg's (1993) KM framework consists of three building blocks and they are: exploring knowledge and its adequacy, assessing value of knowledge, and manage knowledge activity. On the other hand, Nonaka's (1994) SECI model is the most widely discussed theories in KM literature. His KM model was developed from empirical evidences which he gathered in case studies of Japanese firms (Honda, Canon, Matsushita, NEC, Sharp and Kao). For the ICM of Edvinsson and Sullivan (1996), the intellectual capital of any organization has four major ingredients, namely human capital, structural capital, complementary business assets, and intellectual property. In other words, the ICM model is mainly concerned with management of resources for achieving innovation, and commercialization of innovation for monetary benefits. The literatures have also found Carayannis' (1999) views on KM which is slightly different from the other theoreticians in the area of KM and his contribution lies to organizational cognition spiral (OCS) and organizational knowledge network (OK Net) models to KM literatures. Finally, Despres and Chauvel (2000) developed a meta-model that is based on four dimensions of KM, namely, time, type, level and context. They suggested three levels of social aggregation to knowledge: individuals, groups and organizations. It is primarily on the basis of findings of other researchers that they have constructed a theoretical framework of KM, but have been very successful in placing each concept appropriately in connection with others and is completely meaningful.

At the same time, it is also necessary to note that these theoretical frameworks on KM though developed out of simple literature reviews or meta-analysis or live case studies have tried to provide some deeper understanding of managing knowledge across firms in different cultural settings. However, it is contended that none of them can independently claim to unearth the complexity of creating, managing, and using knowledge for any kind of competitive advantages by organizations across culture. Hence, it is asserted that the knowledge management (KM) frameworks of these theoreticians are to an extent industry or culture specific and as a result can not be blindly applied by practitioners.

Leadership, organizational learning and knowledge management: A framework

These research literatures reveal that leadership, organization learning mechanisms and knowledge management practices of the firms are intimately related. In other words, there seems to be a positive influence of one over another and when if implemented by the practicing managers, it will provide a competitive edge to the organizations. The following diagram

summarizes what the above discussed research literatures have to convey to the organizations in operations across culture.

(Proposed by the author)

The diagram as mentioned above states it clearly that the knowledge management practices of a firm is dependent upon learning by the members at an organizational level which to be guided, facilitated, coordinated by the leadership as provided by the top management. Hence, the authors state that learning organization is a result of a particular kind of organizational leadership and which in turn develops a kind of knowledge when managed properly to guarantee corporate success. on the other hand, the authors also note that this framework which has been arrived at conceptually and requires empirical validity before taking them directly to the workplace. At the same time, it is also asserted that though it has not been tested empirically, the authors assume that it may work well in organizations across different industry segments.

CONCLUSIONS

The research paper is based upon the literature review of the past researches conducted across organizations in different cultural settings. The literatures are there in plenty in the areas of leadership, learning organizations and knowledge management practices but no major attempt was noticed to connect them together. After identifying the gaps in the literatures, the authors have put in their efforts to bring to the surface the linkages amongst these three organizationally important variables. At the same time, it is also to note that like other research investigations, this research work has got some limitations which in a way provide scope for another research investigation. It is believed that the findings of this study may be beneficial for the consultants, the practitioners, the academicians as well as the students of the behavioral science discipline.

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Relationship between Knowledge Management and E-Business Adoption: A Malaysian SMEs' perspective

Dr. Alain Yee-Loong Chong, INTI University College, Malaysia
alain.chong@gmail.com
Ms. Shu Yi Tang, INTI University College, Malaysia
ytangsy@hotmail.com
Dr. Keng-Boon Ooi, University Tunku Abdul Rahman, Malaysia
ooikengboon@gmail.com
Dr. BinShan Lin, Louisiana State University in Shreveport, United States
binshan.Lin@LSUS.edu

ABSTRACT

The objective of this paper is to examine the influence of knowledge management on the adoption of e-business in the supply chain of Malaysian small and medium enterprises (SMEs). Questionnaire was distributed to 200 Malaysian SMES with a response rate of 68%. Data were analyzed by employing multiple regression analysis. The results show that knowledge management processes such as knowledge acquisition and knowledge application are significant in affecting Malaysian SMEs' decision to adopt e-business in their supply chain. Knowledge dissemination was found not be significant in affecting the adoption of e-business among Malaysian SMEs.

This study has addressed the previous lack of literatures on the relationship between knowledge management processes and e-business adoption among Malaysian SMEs. Although existing literatures have shown a relationship between knowledge management processes and technology adoption, this study empirically verify an adoption model based on knowledge management processes. Organizations planning to adopt e-business would also be able to applied strategies based on the findings from this research.

Keywords: Knowledge Management, Technology Adoption, E-business, SMEs, Malaysia

INTRODUCTION

In today's business environment, many organizations are seeking to be competitive through the implementation of Information Technologies (IT). With the emergence of Internet, E-Commerce is now a vital tool for companies from supporting business operations to helping them to gain competitive advantages. One application areas of E-Commerce in business include the implementation of e-business tools to the supply chain management (8).

Some of the benefits of e-business implementation in supply chain management include improvements in the speed of response; cost savings; improvements in communications, information and knowledge sharing; reductions in inventory; improvements in efficiency and productivity; harmonization and standardisation of procedures; and better transfer of best practices (44). Although the implementation of E-business in the supply chain has shown many successes in companies such as Dell, Wal-Mart and Cisco (33), the implementation of E-business in supply chain of organizations in developing countries are still relatively a new area of study.

The importance of e-business adoption in supply chain management is well publicized. However, only 30% of Small and Medium Enterprises (SMEs) in Malaysia embraced basic information and communication technology (ICT) primarily as a tool for storing and analyzing proprietary data (29). The Malaysian SMEs is an important part of the Malaysian economy as they contribute to 32% of Malaysia's Gross Domestic Products, 56.4% to the total workforce and 19% to total exports of the country (39). In order for Malaysia to continue its growth and remain competitive to foreign investors, it is important that its SMEs are able to operate efficiently through the adoption of E-business in their supply chain.

Although past studies have tend to look at the adoption of e-business from the technological, environmental and organizational factors (7), there have been a lack of study on the impact of knowledge management on the adoption of e-business tools (25). The barriers to change from traditional business operations to e-business no longer relates to technological prospect such as availability of suitable information systems; but relies on the appropriate management of business related knowledge. The resistance to implement e-business can be related to issues related to lack of knowledge, which obstruct the rate at which SMEs' adoption of e-business (13). Thus, the management of knowledge becomes one of the medium for designing strategic e-business decision.

According to Martin and Matlay (28), knowledge management strategies are considered as an effective and efficient means of successful technological innovation (28). Although studies in the past have supported the claims that knowledge management is important for the technology innovation in an organization (10; 32), many of these studies lack the empirical study on the influence of knowledge management practices on the adoption of e-business (25). Furthermore, many of these studies were not conducted in a developing country as well as SMEs. By studying Malaysia's SMEs, the results generated is more relevant for other developing countries compared to studies conducted in developed or western countries. Thus, this paper aims to investigate if knowledge management practices have an influence on the adoption of e-business in the supply chain of Malaysian SMEs.

LITERATURE REVIEW

Knowledge Management

Knowledge has become one of the critical driving forces for business success (24); hence, the managing of knowledge within the organization has become key focus point for all businesses. Knowledge management (KM) is defined as a process cycle to identify, transfer, store and disseminate the knowledge in order to reuse, awareness, and share and learn it across the organization (31; 43). Previous studies had proposed similar key dimensions for KM model which includes knowledge acquisition, knowledge dissemination, and knowledge application (6; 12; 28). The intention of a KM model is to leverage an organization's superior external performance such as marketplace returns and financial results, to attain superior internal operating efficiencies, and to enhance the quality of life of each individual member of the organization (12). Fink and Floder (14)'s research on impact of knowledge process modeling on SMEs in Europe revealed that the acquisition of knowledge among European SMEs is generated through brain writing, mind mapping and scenario method. Moreover, the intranet with elements of online learning, success stories, and communities of practice are used as a medium for knowledge dissemination. For the purpose of knowledge application, content management system, folder system, database system, document management systems

and project reviews are being used. SMEs in many European countries have established the management of knowledge to a certain extend. On the contrary, many researches and practices on KM focus almost exclusively, on large organizations in Asia. As a result, there is relatively little information available on KM in SMEs. Hence, this study will fill the gap for the understanding of KM among Malaysian SMEs in context of e-business adoption.

KM and E-business adoption

E-business had been promising new avenues for the creation of wealth and business opportunities with its dynamic, rapidly growing, and highly competitive characteristics (2). Papazoglou and Ribbers (36) defined e-business as the conduct of automated business transactions by means of electronic communications networks via the internet and possibly private networks from one end to another end. Organizations worldwide are affected by the emergence of internet and e-business in a broad sense. This is not only the operations and ways of doing business, but also the creation of new sales channels; new occurrences in inter-firm relationships and means of managing business-related information for all organizations appeared (22).

E-business widens the breadth of solutions availability to consumers in almost every industry in the sense that purchasers can now compare and contrast the offerings of providers worldwide. Consequently, there are several e-business issues which in turn require firms to generate distinct knowledge in order to face the challenges and decision to the adoption of e-business in supply chain activities. For example the new consumer value propositions creates new competitive measures where purveyors competitor's profile are no longer bounded geographically and also their business nature and long-established content of strategies have to face profound changes. Moreover, e-business is also significantly reshaping traditional business process in the entire supply chain from product development, customer sales and relationship management to the acquiring of human resource and raw materials procurement (12). The popular e-business way of business operation by Dell Computers as well as IKEA's e-business modelling initiatives had proven the argument's meticulousness (22). In light of this, the emergence and rapid growth of e-business arises the fundamental necessity requisite for both knowledge stock and flow. This is due to the widespread impact on pivotal business domains as trade solutions, rivals, strategies, and business processes of the organization has to be developed, share and leverage extensive knowledge in e-business supply chain context. Besides, proper KM will aid firms in analyzing the effect e-business in competitive environment, strategy, and facets in business operations. Hence, KM efforts in focusing on key current, emerging, and potential trends and patterns in e-business will be able to determine the success or failure in e-business adoption.

Previously, technological adoptions such as EDI and E-commerce adoptions had been extensively researched based on Rogers (37)'s Diffusion of Innovation Theory where the adoption factors lied mainly on relative advantage, compatibility, complexity, trialability and observability; and Tornatzky and Fleischer (42)'s technology-organization-environment (TOE) model where organization, technological and external environment are taken into the adoption considerations (21; 23; 30; 35; 41). Nonetheless, e-business with its constantly changing business temperament and entailment for immense knowledge has made the KM paradigm a major deliberation of the technology adoption (25). Therefore, KM has been included as one of the e-business adoption factors (17). In addition, research outcome revealed that IT investments in the US were increased at a blistering rate of 15% per annum,

as many organizations are envisaging to gain competitive advantage with proper KM in I.T business environment (1). Therefore, the barriers to change from traditional business operations to e-business no longer relates to technological prospect such as availability of suitable information systems; but relies on the appropriate management of business related knowledge. In this regard, this paper will uncover the impact of KM towards e-business adoption among the Malaysia SMEs which small and medium enterprises in developing countries like Malaysia are often neglected for its significance to the global economy.

RESEARCH MODEL AND HYPOTHESES

This study considers e-business supply chain technology implementation in the KM context. KM is contemplated as factor facilitating adoption of e-business supply chain technology among SMEs in Malaysia. Figure 1.0 illustrates the proposed research mode, which hypothesized that KM processes (acquisition, dissemination, and application) affect e-business supply chain technology adoption. The construction of research model and hypotheses are discussed below.

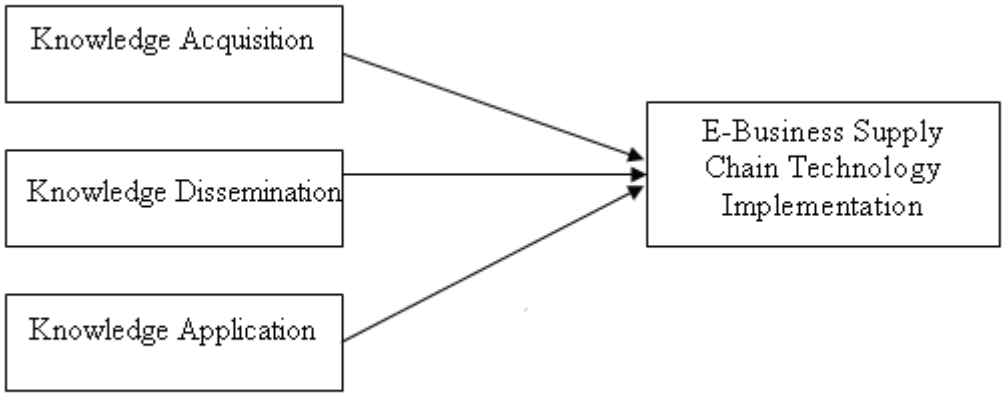

Figure 1.0: Conceptual Model for KM Processes' Influence on E-business Adoption

Knowledge Acquisition

Knowledge acquisition is defined as the first step of KM and it includes business processes that use existing knowledge and the capture new knowledge (16; 25). The process requires rigorous effort and experience in recognizing and capturing new knowledge. The ability to survive and thrive relies, to some extent, an organization's ability to maintain and retain old and new knowledge in the face of complexity, uncertainty and rapid change (11). Hence the acquisition of knowledge is vital to the organization, especially key decisions made based on experience and information which usually shared informally. Cagarra-Navarro (3) described that resources are scarce in SMEs and chief knowledge officer is normally difficult to justify, thus knowledge is likely to be obtained from secondary data like trade journals, sector research, professional magazines, or even personal contacts which is customarily unable to cope with the fast changing business environment. Nevertheless, the acquirement of knowledge in customer-supplier orientation context can be monitored with e-business systems. E-business will enable organizations in determining the relevant customers or suppliers, processes and domain knowledge needed to operate business activities successfully. As a result, the e-business infrastructure involves not only technological initiatives but also is

driven by acquisition knowledge and skills (25). Relationships between knowledge acquisitions capabilities thus are expected to be positively related to e-business adoption. In this regard, the following hypothesis is formulated:

H1: Knowledge acquisition will positively affect e-business supply chain technology adoption.

Knowledge Dissemination

Knowledge dissemination consists of knowledge transfer and knowledge sharing (11). Thus, the focus of knowledge dissemination is on the business processes that distribute knowledge among all individuals participating in the supply chain (25). The process of knowledge dissemination itself is a main challenge to companies. Lack of communication skills and rapid change in information and communication technologies are highlighted as some of the main concerns for knowledge sharing (11). This is due to the lack of capital investment for systematic use of information, developing organization processes and technology development for rapid growth. Notwithstanding, knowledge transfer and sharing is important for improving performance of the firm in the e-business context (25). Furthermore, Darroch and McNaughton (9)'s study on link between KM practices and types of innovation found that knowledge dissemination and innovation have direct linkage between each other. As technology adoptions often yield innovation, it is equitable that knowledge dissemination will have impact on e-business adoption (4). With this perception, organizations will be more enthusiastic and allocate more effort for the e-business initiative. Therefore, knowledge dissemination is expected to be positively associated with the implementation of e-business supply chain technology decision. The following hypothesis is formulated:

H2: Knowledge dissemination will positively affect e-business supply chain technology adoption.

Knowledge Application

Knowledge application is defined as the business processes through which effective storage and retrieval mechanisms enable a firm to access knowledge easily (25). It includes the assimilation of the knowledge generated in the acquisition and dissemination levels (3) and the knowledge is then applied in the routine business activities for performance enhancement. From the technological perspectives, knowledge transfer, knowledge integration and practical application of knowledge are the main elements for developing technological capabilities (25). Based on Cagarra-Navarro (3)'s research, analytical results revealed firms that stimulate and improve organizational knowledge application are more likely to adopt e-business systems and is consistent with the conceptualization of knowledge application as the facilitator of successful technological innovation (16). These findings can also be supported by Lin and Lee (25)'s study outcome which stated knowledge application enables employees to both use existing knowledge and create new that are crucial for e-business adoption. Consequently, firms that stimulate and improve organizational application of knowledge are more likely to adopt new technology, inclusive of the internet-enabled business opportunities. The following hypothesis is formulated:

H3: Knowledge application will positively affect e-business supply chain technology adoption.

METHODOLOGY

Data Collection and Sampling

In order to test the hypothesis in this study, a survey instrument was developed. The survey contained 29 items for measuring the 4 constructs in the questionnaire. Table I shows the sources of the constructs used in this study.

Table 1: Constructs and their sources

Constructs	Number of Items	References
Knowledge Acquisition	5	Cagarra-Navarro (3); Egbu et al (11); Fahey et al. (12); Lin and Lee (25);
Knowledge Dissemination	5	Egbu et al. (11); Fahey et al. (12); Lin and Lee (25)
Knowledge Application	6	Cagarra-Navarro (3); Fahey et al. (12); Lin and Lee (25);
E-business adoption	13	Cassivi (5); Thatcher (40);

The SMEs within Malaysia are randomly selected by referring to the official SMEs list published in Small and Medium Industries Development Corporation (SMIDEC) (2008) (39) website.

In order to ensure that the sample in this study is adequate for regression analysis, we applied the formula from Green (18) who suggested that the sample size (N) should be greater than 50+8m (where m is the number of independent variables) for testing the multiple correlation and N>104+m for testing individual predictors. As there are 3 independent variables in this study, the minimum sample size needed will be 74 (N>50+8*3). As a result, a selection of 200 Malaysian SMEs as the sample size would be acceptable for this research and attaining the rule of thumb criteria.

The set of constructed questionnaire were distributed to 200 SMEs across Malaysia. Questionnaires were disseminated directly to the firms' top management as it is believed that these management level personnel comprise similar level of understanding on organizations' management of inter-organizational relationships and knowledge due to similar level of hierarchy, seniority, experience, and unit affiliations. As a result, feedbacks obtain will provide higher percentage of reliability to the analysis of data.

Questionnaire distribution and collection were completed within six weeks upon date of dissemination. A total of 200 sets of questionnaires were distributed randomly and 147 sets have been successfully collected. However, there were 11 sets of feedbacks which were unusable due to partial respond and missing data. Therefore, data analysis is conducted based on 136 sets of useful feedbacks with 68% of respond rate.

VARIABLE MEASUREMENT

Independent Variables

The independent variables used in the study were derived and modified from existing literatures (See Table I).

A total of 16 questions were developed to capture the KM processes used in this study. A five-point Likert scale (i.e. "1" denoted as strongly disagreed, "2" denoted as disagree, "3" denoted as neutral, "4" denoted as agree and "5" denoted as strongly agree) were used in this study.

Dependent Variable

In order to measure the e-business tools adoption in the supply chain, a list of e-business tools used in supply chain were adapted from Thatcher (40) and Cassivi (5). As Chou et al (8) stated, the current e-business tools used by organizations have ranged from B2B in the 90s to collaborative commerce (c-commerce) tools from 2000s to current. Therefore in order to have a comprehensive list of e-business tools in supply chain, we have included both e-commerce and c-commerce in the supply chain in order to capture the actual e-business adoption in the supply chain by the Malaysian SMEs.

DATA ANALYSIS

Profile of organizations

A total of 136 responses have been successfully collected. Demographics profile of the survey is illustrated in Table 2.0. The organizations are categorized by industry, number of full-tome employees, annual sales turnover, and length of time of the organization.

The industry distribution of the survey respondents is 26.5% manufacturing companies, 25% manufacturing-related companies, and 48.5% of firms in the service industry. Majority of the respondents has more than twenty full-time employees (59.6%), followed by 40 organizations with five to nineteen full-time employees and 11% of the firms consist of less than five full-time employees. From the other point of view, there are 33.8% of SMEs have annual sales turnover exceeding RM1 million, 37.5% between Rm200,000 and RM1 million, and 28.7% less than RM200,000. Demographic of respondents is also sorted by length of time of the organization. There are 11 firms have been operating for over two decades, 21 have been in the industry between ten to twenty years, 24 operate around five to ten years, 36 between three to five years, 28 one to two years, and 16 firms are established less than a year.

Table 2: Respondents Demographics Profile

Variables		Frequency	Percentage
Industry	Manufacturing	36	26.5%
	Manufacturing-related	34	25%
	Service	66	48.5%
Number of Full-time Employees	Less than 5	15	11%
	Between 5 to 19	40	29.4%
	More than 20	81	59.6%
Annual Sales Turnover	Less than RM200,000	39	28.7%
	Between RM200,000 and RM1 million	51	37.5%
	More than RM1 million	46	33.8%
Length of time of organization	Less than 1 year	16	11.8%
	1 to 2 years	28	20.6%
	3 to 5 years	36	26.5%
	5 to 10 years	24	17.6%
	10 to 20 years	21	15.4%
	Above 20 years	11	8.1%

Normality Test

Before conducting the multiple regression analysis for this study, it is important that the data in this study are normally distributed. As the data for this study is greater than 50, Kolmogorov-Smirnov's test is applied to test for data normality (19). The significant level for the Kolmogorov-Smirnov test shows a P value of 0.074 which is more than 0.05, hence normality is assumed.

Scale reliability

In order to ensure the precise measurements for this study, the data collected from the survey is tested for reliability as noisy data can be difficult to interpret (20). The construct of measurement for data reliability is tested using Cronbach's alpha coefficient. The reliability coefficient of 0.70 or higher will be considered "acceptable" in research situations. Hence, the standard of Cronbach's alpha 0.70 will be applied to variables of this study as to be accepted or deleted. Table 3.0 shows the reliability coefficients for the variables used in this study. As the cronbach's alpha coefficients for all the variables are greater than 0.70, the data used in this study are reliable.

Table 3: Reliability Analysis

Constructs	Cronbach's Alpha
E-business Tools	0.923
Knowledge Acquisition	0.758
Knowledge Dissemination	0.806
Knowledge Application	0.725

Multiple Regression Analysis

Multiple regression analysis was applied to test the hypotheses in this study. Table 4 shows the result of the multiple regression analysis. Durbin-Watson statistic is used for testing autocorrelation (38). As a rule of thumb, a Durbin-Watson statistic has to be in the range of 1.5 to 2.5, meaning that a notion may be rejected as data are autocorrelated instead of assuming independence of observations (15). The Durbin-Watson for this study falls between the acceptable range (1.769) indicating no autocorrelation problem in the data. Hence, error terms are assumed to be independent and non-autocorrelated.

In order to avoid the occurrence of multicollinearity, tolerance indicator is suggested to be more than 0.1 and variation inflation factors (VIF) to be greater than 10 (34). The VIF and Tolerance value shown in Table 4 shows that there is no multicollinearity problem as the predictor variables have tolerance of greater than 0.10 and VIF value of lesser than 10.

The F-statistics produced (F = 27.358) was significant (P < 0.05) thus indicating that there is a statistically significant relationship between the KM processes and the adoption of e-business in supply chain by Malaysian SMEs. The coefficient of determination R^2 was 38.3 percent indicating that the KM processes significantly account for 38.3 percent in the adoption of e-business among Malaysian SMEs.

Table 4: Multiple Regression Analysis

Predictor variables	Beta	t-value	Sig.	Tolerance	VIF
Knowledge Acquisition	.361	3.602	.000	.466	2.144
Knowledge Dissemination	.002	.020	.984	.428	2.335
Knowledge Application	.316	3.073	.003	.442	2.261

Overall model F= 27.358, $p<0.01$, $R^2 = 0.383$, Adjusted $R^2 = 0.369$; Durbin-Watson test = 1.769

The result shows that knowledge acquisition ($p < 0.01$) and knowledge application ($p < 0.05$) are both significant in influencing the adoption of e-business while knowledge dissemination ($p > 0.05$) is not significant in influencing the adoption of e-business. Therefore H1 and H3 are supported while H2 is rejected.

DISCUSSION

Knowledge acquisition surfaces as the most significant factor for influencing e-business supply chain technology implementation in this study. This has made the determinant parallel with previous studies (11; 27) where conceptualization of knowledge acquisition is facilitator for successful technological adoption. Business competition is becoming more intense in this day and age. This had push organizations to acquire pervasive data and information in order to be sustainable in the market. Consequently, SMEs are also yearning to expand their knowledge about their own business capabilities as well as to gather external information in areas like economy, technology, financial, and so on. In regard of this, knowledge acquisition becomes strong focus in all business aspect. Alternatively, e-business is able to provide accumulation of information. This will highly raise the aspiration for e-business implementation. Therefore, for SMEs that are demanding for knowledge acquisition will positively accept the decision for adoption of e-business supply chain technology. This

resulted in creating the significant impact of knowledge acquisition towards e-business implementation.

Knowledge application is found to have an influence on the adoption of e-business among Malaysian SMEs. As cited in Lin and Lee (25) and Cagarra-Navarro (3), e-business differs from many previously studied areas of IT adoption as it integrates intra- and inter-organizational business processes. Consequently, e-business supply chain technology is able to facilitate knowledge to be acquired internal and externally and provide SMEs to both use existing information and create new knowledge. This will enthusiastically encourage SMEs to implementation e-business technology. Hence, the factor becomes significant to explain the adoption of e-business in this study as knowledge application allows SMEs to generate and exploit information rapidly and effectively

Knowledge dissemination is found to be not significant in influencing the adoption of e-business among Malaysian SMEs. The result can be caused by Malaysian SME's reluctant to share information. This is similar to study found in Lin and Lee (25)'s study whereby they found that Taiwanese firms are reluctant to share information as employees are afraid to share knowledge for the fear that their colleagues will be promoted at their expense. Knowledge within many Malaysian SMEs are also confidentially treated. Any widespread sharing of this knowledge is perceived to reduce the company's competitive and sustainability. Thus although knowledge dissemination is important for the success of e-business adoption (7; 25), the culture of many Malaysian SMEs do not encourage the notion of sharing information.

CONCLUSION

This study developed a research model that examine whether KM processes influence the adoption of e-business in the supply chain of Malaysian SMEs. Through empirical analysis of the data, the result shows that KM processes such as knowledge acquisition and knowledge application in the SMEs have a positive influence on the adoption of e-business among Malaysian SMEs. This study has several implications.

Theoretical implication

Past studies on the relationships between KM on e-business adoption within organizations have mainly concentrated on multinational companies or larger organizations and have neglected to focus on developing countries' SMEs. This is important as unlike developed nations, developing countries' SMEs are only at the early stage of e-business adoption or are starting to adopt e-business. As countries such as Malaysia moved from manufacturing focused towards service focused, it is important that many of their organizations are implementing technologies such as e-business in their supply chain.

Outcomes from this study insinuated that KM processes such as knowledge application and knowledge acquisition have significant impact in explaining e-business adoption for supply chain. Past studies have mainly focused on studying technology adoption using variables such as environmental, organization attributes as well as innovation's attributes. This study offered empirical evidence to confirm the validity of the research model which focuses on KM processes, and also contributed to the growing literature on rapid changing technology adoption.

Managerial implication

In managerial perspective, indentifying the major determinants of KM processes for e-business adoption among Malaysian SMEs is important for SME from various industries which are constantly searching for ways to improve business in the current volatile economic environment.

Large organizations that have collaborations with SMEs can also aim to improve the adoption of e-business adoption with their partners through improving the KM processes between them.

Limitations

There are several limitations in this study. Firstly, as this study focused only in Malaysia, the results from this study need further testing in other developing countries before the model can be generalized to all developing countries. Secondly, as with many adoption studies, not all adoption factors can be included in this study. Future study can include national culture to conduct a multi-country comparison study. Lastly, this study only focused on SMEs in Malaysia. Future study can include both SMEs and larger organizations to compare if the results are different between them.

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THE ROLE OF TQM AND KM IN SUPPLY CHAIN LEARNING: A CONCEPTUAL MODEL

Siew-Phaik Loke, Universiti Tunku Abdul Rahman, Malaysia
lokesp@utar.edu.my
Keng-Boon Ooi, Universiti Tunku Abdul Rahman, Malaysia
ooikengboon@gmail.com
Boon-In Tan, Universiti Tunku Abdul Rahman, Malaysia
tanbi@utar.edu.my

ABSTRACT

Firms today focus on their supply chain management (SCM) in order to improve the product quality and lead time due to intensified global competition, shorter product life cycle and increased customers' expectation. This has caused many firms, even leading firms, to react by continually building superior knowledge as their own competitive advantage capabilities. Knowledge management is particularly relevant to every stage in SCM because regardless of the phases of the supply chain process, making decisions at the right time depends largely on the quality and timeliness of the data. While integrated supply chain aims to create value through learning, firms must recognize their practices and capabilities as critical factors of resource management and effective learning. Here, the total quality management (TQM) is presented for the purpose of understanding the association between quality management and knowledge management in supply chain learning (SCL). This study provides a basis for developing a model to advance KM, TQM and SCL research literatures. The practical implication of this study could be useful for business managers, who want to enhance SCL through implementing KM and TQM concepts that support their organization's SCL efforts. This study makes a significant contribution by developing a proposed model as a methodological example which can be useful for tracking the degree of KM and TQM effects on SCL. Organizations could use this framework to do a pre-test baseline measurement, and then periodically re-assess the effects of any KM and TQM change.

Keywords: Total Quality Management (TQM), Knowledge Management (KM), Supply Chain, Learning (SCL)

INTRODUCTION

Stiff global competitions, rapid introduction of short-life cycle products and increased customers' expectation have forced the companies not only to focus more on their SCM (Tan, Lyman and Wisner, 2002) but also to invest in close relationships with firms that possess complementary resources and skills as to effectively compete in the marketplace (Dyer and Singh, 1998). Understanding how firms can achieve competitive advantages has interested management scholar for a long time, particularly in the areas on how strategic plan and business policy of a firm can add and create value to its supply chain. Motwani, Larson and Ahuja (1998) argued that firms compete in global markets have to periodically study their supply chain in order to continuously benefit from savings in terms of cost and time. Although SCM does not seem to be a quick fix for every business situation, a firm's synergies can be greatly leveraged if the supply chain is successfully implemented and managed (Ellram, 1990).

Kehoe and Boughton (2001) stressed that the efficiency and timeliness of information transfer are key to enhance supply chain operation since accurate information exchange increases operational efficiencies and market responsiveness. Knowledge-based businesses which enable instant responses with real time information will contribute greatly to the companies' competitive advantage (Neef, 1997). Knowledge management also benefits the companies in quality and productivity improvement (McCampbell, Clare and Gitters, 1999). Researchers have found that, under demand uncertainty, an effective information sharing and ordering coordination greatly improves supply chain performance in cost savings, inventory reduction and increased customer satisfaction (Lee, Padmanabhan and Whang, 1997; Zhao, Xin and Zhang, 2002). A learning environment is therefore needed for members in a supply chain to ensure optimal value creation through effective partnership as highlighted by Motwani et al. (1998, p.352):

> "Strategic partnerships (information sharing and other firms of linkages that involve shared processes or activities that enhance intellectual capital) between supplier and customer value chains are an important source of competitive advantage, with advances in information technology creating new opportunities to jointly optimize the total industry value chain across multiple organizations".

Greater market performance has been linked to a higher level of process knowledge application spanning the supply chain (Claycomb, Dröge and Germain, 2001). According to Carlile (2004), learning takes place at individual level and subsequently passes through different boundaries to flow to higher levels of aggregation: the group (such as team and department), the organization and the dyad. Learning, therefore, can be an intra-firm or an inter-firm processes (Bessant, Kaplinsky and Lamming, 2003). Most learning organizations construct their structures and strategy in order to maximize their own experiences and experiences of others (Maqsood, Walker and Finegan, 2007). Operation strategies that well-integrated with knowledge unleash the creativity and innovation of the supply chain members as these companies start to collaborate by embracing SCM and act as an integrated entity (Maqsood et al., 2007).

While recognizing the role of knowledge as a source of competitive advantage (Nonaka, 1994; Spender and Grant, 1996), building a learning organization is neither an easy task (Schien, 2002) nor a natural feature of business networks (Bessant et al., 2003). Firms are challenged to learn and to keep pace with new opportunities and threats beyond their boundaries (Bessant et al., 2003). Specifically, learning efforts in the supply chain need to be more integrated and systematic due to the advances in e-business solution, increased customer expectation and customization (Preiss and Murray, 2005). Building on this notion, this paper attempts to understand the relationships among KM, TQM in SCL.

Given the above reasons, this paper begins by describing how researchers and practitioners have addressed the association between KM and SCL in the work context. Then, the linkages between TQM and KM are reviewed followed by the association between TQM and SCL. The review of literature leads to the development of propositions for this study and then followed by the proposed conceptual model. Finally, we discuss managerial implications for this study.

LITERATURE REVIEW

Knowledge Management (KM) and Supply Chain Learning (SCL)

A crucial concept in contemporary business management relates to the knowledge creation and application. To face the ever presence of challenges in the business world we have witnessed a paradigm shift in firms from focusing on management of physical goods to intangible assets such as knowledge (Nielsen, 2005). The traditional factor of competitive production is losing their significance when knowledge emerges to become the greatest determinant in achieving competitiveness in this century. Values and synergies that created via the KM efforts are powerful particularly in the area of innovation enhancement.

Collins, Dunne and O'Keeffe (2002) described knowledge as a strategic asset of a firm. The concept of knowledge, in fact, appears as early as in 1960s. Polanyi (1966) distinguished explicit knowledge from tacit knowledge. According to Duffy (2000), the explicit knowledge is documented and made public, structured, fixed-content, externalized and conscious. It can be verbally captured and shared through information technology and electronic media (Duffy, 2000; Smith, 2001). The explicit knowledge is also known as the academic knowledge or "know-what" which is commonly based on established work processes (Smith, 2001). On the other hand, the tacit knowledge is more intangible and resides in the individual mind, behavior and perception (Thorne and Dutnell, 1997; Duffy, 2000). Tacit knowledge is practical, action-oriented knowledge or "know-how" based on practices or acquired by experience (Duffy, 2000; Smith, 2001).

Learning is central to the study of knowledge management because it serves as an important block for knowledge transfer. Most literature distinguishes individual learning and organizational learning (Dahlgaard-Park, 2006). Spekman, Spear and Kamauff (2002) argued that learning concerns the acquisition of new insights/ knowledge that contributes to the firm's improvement whereas organizational learning focuses on the "accumulation of the knowledge of all the company managers, it encompasses also the learning systems and other processes developed by the company to influence behaviors of others, to establish norms that support a learning environment, and to endure that the knowledge acquired is passed from member to member (p. 43)". Similarly, Simon (1991) stated that organizational learning can happen through either "learning from its members" or "ingesting new members who have knowledge the organization didn't previously have". Lam (2000) identified a four-fold typology in understanding the complexity of learning in relation to different organizational forms and levels of analysis as one of the first conceptual frameworks in organizational learning literature. Learning for a simple dyadic relationship between two players in a supply chain can be very different from learning for a network relationship where there are multi firms involved. Bessant et al. (2003) thus developed a matrix to recognize the different modes in which the supply chain learning can be enabled. Although Spekman et al. (2002) did not provide a specific definition on SCL, they utilized two measures, guided partly by Hamel (1991), to reflect the relative magnitude to which supply chains encourage and/or provide supports to the learning process: (1) the extent to which there is supply chain structure that supports a learning environment such as structures for ideas generation and sharing across the supply chain, and (2) the extent to which attitude and behaviors within supply chain encourages learning process such as ideas sharing and supported experimentation.

Claycomb et al. (2001) classified knowledge applied to facilitate exchange within the supply chain into: (1) upstream, between the firm and its suppliers, (2) within the firm itself, to enhance its operation and (3) downstream, between the firm and its customers or distributors. Highlighted on the concepts of "know-what", "know-how" and "know-why", Fahey, Srivastava, Sharon and Smith (2001) illustrated the key knowledge issues on the SCM process to help managers in producing value to their customers (see Table 1).

Table 1: Key Knowledge Issues on the SCM Process (adopted from Fahey et al., 2001)

Know-What	• What changes are needed within the supply chain to lower costs and increase responsiveness? • What significant changes are realigning your vendor or customer relationships (pricing, billing, ordering, processing, etc.)? • What areas of the supply chain can benefit from e-business enablement? • What types out outsourcing relationships within SCM have been successful?
Know-How	• How do you use supply chain transparency to make more informed operational decisions? • How do you enable communication and collaboration across the supply chain while protecting confidentiality and privacy issues? • How can you leverage your relationships with vendors, partners, and competitors to make SCM processes more effective? • How can you improve your outsourcing relationships? • How have key competitors leveraged collaboration capabilities in your markets? • How can you draw value from the transactions performed across your supply chain?
Know-Why	• Why has the supply chain become an even more important piece of your market intelligence? • Why is it necessary to reevaluate your SM processes? • Why is that your outsourcing is not as efficient and smooth as needed?

While the supply chain partners have long taken the advantages of technology to streamline their operations and to reduce lead-time, new strategy today extended to the usefulness of information sharing and knowledge in supporting collaboration and decision making (Eisenhart, 2001). Spekman et al. (2002) also demonstrated that the principles of knowledge as a competitive source where it could be extended from individual firm to the whole supply chain. Application of KM in operational contexts not only allow greater understanding on customers, suppliers and competitors but also guide the design of products and services, planning and control of performance achievement (Armistead, 1999). More importantly, KM facilitates and encourages learning, unlearning and relearning among the supply chain members. Therefore, based on the above discussion, the first proposition is:

Proposition 1: The higher level of KM will lead to higher level of SCL in the organization.

Relationship between TQM and Knowledge Management

The notion of TQM, or total quality management traced its origin from Feigenbaum in 1950s. (Slack, Chambers and Johnston, 2004, p.719.) He defines TQM as:

> "an effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as so as to enable production and service at the most economical levels which allow for full customer satisfaction."

A review of literature discussing the relationship between TQM and KM behaviour suggests that there are strong links between these two relationships, particularly in daily business and operations (Huang and Lien, 2005). Many researchers have recognized this point of view and have tried to link TQM and KM together (Ju et al., 2006; Molina, Montes and Fuentes, 2004; Yang, 2004). The practical philosophy of TQM can be defined as "understanding and discovering" a better processes, while KM concentrates on previously invented or identified methods of accomplishing certain tasks and setting them as best practices (Prajogo and Sohal, 2006; Hsu and Shen, 2005; Janpen, Praneetpolgrang and Horadal, 2006). According to Zetie (2002), the concepts of TQM and KM are closely linked and are all aspects of a much more fundamental concept of organizational development. He further emphasized that the recognition of the relationship between TQM and KM has both theoretical and practical significance. From the theoretical point of view, the implication is a possible broader use of explanatory models developed in a specific context. On a more practical level, it increases the implementation options for those seeking to bring about organizational change (Ju et. al., 2006).

Both TQM and KM approaches are the work-processes of organizational improvements (Janpen et al., 2006). According to the review of the prior empirical study on TQM, researchers have classified TQM construct in several ways although they are complementary to each other (Prajogo and Sohal, 2003). Thus, difficulty of achieving consensus on the components and dimensions of TQM arises due to the inconsistency in the past research (Hoang, Igel and Laosirihongthong, 2006). A comprehensive review of TQM literature proved that the TQM concept could be anchored into leadership, strategic planning, customer focus, and people management (HRM) (Shenawy, Baker and Lemak, 2007; Reed, Lemak and Mero, 2000). According to MacNeil (2001), top management could add significantly to the improvement of core competencies through their role as facilitators of organization learning in the workplace, specifically by establishing a knowledge management activities climate in which employees are encouraged to apply their explicit and tacit knowledge to problem-solving situations. Researchers have acknowledged that the success of leaders promoting knowledge management environment (e.g. Macneil, 2001; Bryant, 2003; Davenport and Volpel, 2001). Liebowitz (1999) reported that one of the keys for driving the success of KM is to have a clear and well-planned strategy. With this strategy, it provides the fundamentals for how a firm can deploy its capabilities and resources to achieve its KM objectives. O'Dell, Wiig and Odem (1999) further stressed that customer focus strategy is to capture knowledge about customers, understanding of customers' needs and using the knowledge within the organization to counteract customer problems. In an empirical study, Stankosky and Baldanza (2001) concluded those understanding customers' requirements and problem well is vital and this is one main factor of continued improvements and innovations to the organizations. In a very interesting study, Lin (2007) found that people usually enjoy helping others and to improve self knowledge efficacy. With senior management support and proper organizational rewards knowledge sharing processes and superior innovation could be further enhanced. Indeed, various researchers in the literatures have emphasized the importance of HRM as a way to improve the transfer of knowledge, especially in the form of technology know-how (e.g. Sparkes and Miyake, 2000; Zander and Kogut, 1995) as both HRM and KM have grown more sophisticated and multifaceted (Gloet and Berrell, 2006; Yahya and Goh, 2002). Therefore, the second proposition is as follows:

Proposition 2: The greater emphasis on TQM concepts will lead to a higher level of KM in the organization.

Relationship between TQM and Supply Chain Learning (SCL)

Learning is necessary in an organization as the world, in particularly the business world, is ever changing at a rapid pace. Simply, learning is acquiring new techniques, knowledge or technology. It could be from experiences or sharing of knowledge from external inputs. In an organization, learning becomes even more complicated as it encompasses many dimensions. Sohal and Morrison (1995) opined that TQM, if practiced as philosophy with a set of techniques, can be an effective vehicle for organization learning. Similarly, TQM involves multi-disciplinary approach including management science, organization theory, production management, cultural anthropology, psychology and organizational development (Easterby-Smith, 1997).

SCM plays a key role in the success of a business organization. Learning organization is seen to be skilled at creating, acquiring and transferring knowledge and the results should be changing the behavior and practices within the organization from the new knowledge acquired (Garvin, 1993). He also pointed out that commitment to organization learning is vital to ensure ever improvement to getting something new as the outcome through learning, be it a new product or a new process; all requires new knowledge and new perspective. SCM is not just a cost centre to an organization but it could be a source of competitive advantage if it is managed effectively and efficiently. The benefits are many, such as higher ROI (return on investment), lower cost and higher returns to shareholders (Spekman et al., 2002). The purpose of SCM could be summarized as a focus on satisfying end customers, to manage the supply chain efficiently and to have the chain flexibly. The activities of supply chain include purchasing and supply management, physical distribution management, logistics and material management (Slack et al., 2004). Due to its complexity, SCM technology and techniques continue to develop and evolve. To improve and excel in SCM, the practitioners are aware that they need to learn the latest technology and techniques in order to perform better or at least to be on par with the contemporary peers in order to be competitive. This is known as part of the formation of a learning organization philosophy. Based on observations and theories discussed, TQM has a positive role to play in the organization learning where SCM is one of the key components for improving organizational management. Thus we propose that that:-

Proposition 3: The greater adoption of TQM practices will lead to higher the level of SCL in the organization.

CONCEPTUAL RESEARCH FRAMEWORK

Based on the above review of the literature, the following conceptual model is proposed demonstrating the relationships among TQM, KM and SCL. The model is shown in Figure 1.

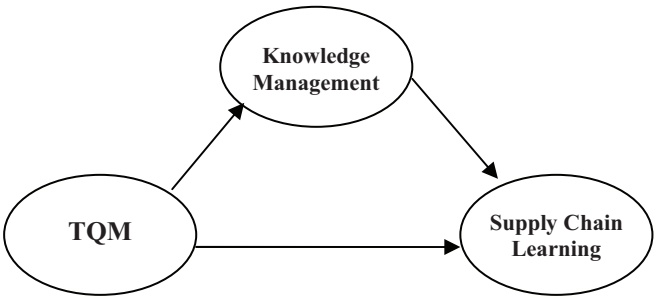

Figure 1: Conceptual Research Model

IMPLICATIONS

The conceptual model contributes to the body of knowledge for both academics and practitioners. From the theoretical perspective, this study contributes to the body of knowledge in TQM, KM and SCL, and provides a proposed conceptual model with an initial insight of what may be a valuable connection between these concepts. The proposed conceptual model in this study develops the SCL concept from KM and TQM perspectives. The impacts of KM and TQM to SCL are developed. The contributions of KM and TQM are described through a literature review. Three major propositions are proposed. First, the higher level of KM will lead to higher level of SCL in the organization. Secondly, the greater emphasis on TQM concepts will lead to a higher level of KM in the organization. Thirdly, the greater emphasis on TQM concepts will lead to a higher level of SCL in the organization. As argued by Spekman et al. (2002) that shared culture is a pre-requisite for learning, this proposed framework assumes the presence of a conducive learning culture or shared culture in the organization is needed to instill knowledge management programmes. SCL is crucial to the competitiveness of any organization that participates in and manages the supply chain regardless of whether they have formal TQM or KM programmes. If the organizations realized the importance of SCM as an integral part of their business successes, and would be willing and making efforts to improve, these organizations would be deemed to be in a better position to learn and acquire new ideas. On the other hand, the concept of learning and improving SCM would motivate organization to build a culture of KM and to adopt TQM practices. In order to fully comprehend the proposed framework, further exploration is still needed to know the strength of association among the three concepts in the model.

From to the practical point of view, the study could be useful for senior management to review their TQM and KM programs on regular basis in order to gain a sense of how these two concepts can influence SCL within their organizations. This study is also vital and beneficial for senior management of companies practicing TQM and KM who wants to address SCL in the work context could benefit from the proposed framework. It is believed that this proposed framework will provide valuable insights about the association among TQM, KM and SCL. Numerous benefits, ranging from cost reduction to the knowledge transfer and creation of synergies throughout the entire supply chain, are expected if TQM and KM are implemented effectively to facilitate the SCL.

CONCLUSION

In conclusion, the purpose of this paper is to provide a thought model for examining and understand the relationship among TQM, KM and SCL. This proposed conceptual model will serve as the catalyst for future research. Further research should be conducted using multivariate analysis to test and validate the model. Currently the authors are designing the questionnaire to collect data from respondents in various sectors to validate the proposed model shown in Figure 1 and its three propositions. The results shall be reported in the future article. Hopefully the model could advance the study in this area and provide a channel for both practitioners and academicians to understand better of the relationships among TQM, KM and SCL.

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THE RELATIONSHIP OF ORGANIZATIONAL POLITICS WITH EMPLOYEES' KNOWLEDGE SHARING BEHAVIOR AND WORK ENGAGEMENT

Dr. Bindu Gupta, Institute of Management Technology, Ghaziabad, India
bindugupta@yahoo.com

ABSTRACT

Politics is an inevitable fact of organization life. Political behavior in an organization is mostly covert and subject to differences in perception. The presence of organizational politics is a situational indicator based on individual interpretations of the organizational climate that is expected to influence employee behavior. If employees perceive a highly political organizational atmosphere, all behavior in the organization will be interpreted in that light. The objective of the present research was to test a model of the relationship between employees' perceptions of organizational politics and their tendency to engage in knowledge sharing behavior and their work engagement. It conjectures that if employees perceive more politics in organization, they are less likely to be involved in knowledge sharing behavior and will be less engaged. It also examined the influence of organizational politics on job satisfaction and intention to quit. Data were collected from 114 full-time employees. Results indicated that employees' perceptions of organizational politics significantly influence work engagement, job satisfaction and intention to quit and unrelated to knowledge sharing behavior.

Keywords: Organizational politics, Knowledge sharing, Work-engagement, Job satisfaction, Intention to quit

INTRODUCTION

Organizations are inherently political place. Organizational politics is an elusive phenomenon that represents some unique domains of organizational culture and climate (Shaker, 1987; Frank, 1993). It is common to find organizational members engaging in influence attempts to protect or further their interests. The role of power in organizations is often viewed normatively as a negative or distorting force (Mintzberg, 1989). These critiques are particularly applied to the overt politicking behaviour associated with attempts to secure privileged access to decision-making and resources, or achieve control over others (French & Raven, 1959; Kipnis et al., 1980; Pfeffer, 1981). It is often considered dysfunctional because it has the potential to disrupt organizational efficiency and effectiveness (Kacmar et al., 1999). Some scholars stated bluntly that "politics in organizations is basically a negative process" (Block, 1988). According to Ferris and King (1991), organizational politics describe a dark side of workplace activity, implying that political behavior may lead to functional as well as dysfunctional outcomes for individuals, groups, or organizations. Organizational politics yield a competitive disadvantage by diluting company-level performance (Eisenhardt & Bourgeois, 1988). Various behavior like discrediting one's rival at work in order to get ahead, not sharing useful information with other employees in

order to increase one's power over them, and doing favors for the boss to secure a high salary increase are labeled as political behaviors in organization.

There have been two alternative approaches to understand the politics in organization. The first approach treats organizational politics as a simple aggregated measure of influence tactics by employees in organizations (e.g., Kipnis et al., 1980). The other approach is more cognitive analysis as proposed by Lewin (1936); it suggests a perceptual measure of organizational politics named a Perceptions of Organizational Politics Scale (e.g. Ferris et al., 1989). Political behavior in organization is mostly covert and subject to differences in perception (Drory and Romn, 1988; Kacmar et al., 1999). Lewin (1936) reported that people's attitudes and behaviors are determined mostly by their perceptions of reality and not reality per se. Workplace politics may best be conceived of as a state of mind rather than as an objective state (Gandz and Murray, 1980). These researchers and observations imply that the presence of organizational politics is a situational indicator based on individual interpretations of the organizational climate which is expected to influence employee behavior. The perception of a politically charged atmosphere reflects actions taken by individuals that are beyond the parameters of accepted organizational behavior (Mintzberg, 1983, 1985). If employees perceive a highly political organizational atmosphere, all behavior in the company will be interpreted in that light and studies have indicated they have an immanent effect on organizational climate and on a variety of work outcomes (Kacmar and Ferris, 1991; Ferris and Kacmar, 1992; Folger et al., 1992; Ferris et al., 1996; Vigoda, 2000a, 2000b). Organizational politics could result in several work outcomes, such as job anxiety, job involvement, job satisfaction, turnover and absenteeism (Ferris et al., 1989). Other studies have examined the effect of organizational politics on organizational commitment, loyalty, innovation, tension-and stress related factors, job performance and organizational citizenship behaviors (Bozeman et al., 1996; Cropanzano et al., 1997; Drory, 1993; Kacmar et al., 1999; Parker et al., 1995; Randall et al., 1999; Vigoda, 2000a, 2000b). This study focuses on two unexamined and most desired behavior in today's context namely knowledge sharing behavior and work engagement and two widely studied behavior namely job satisfaction and intention to quit.

Political behavior in organization is defined as influencing others to get what you want (Porter et al., 1981). Mintzberg (1983, p. 172) defined politics as informal, parochial, typically divisive and illegitimate behavior that is aimed at displacing legitimate power. It also has been defined as an intentional social influence process in which behavior is strategically designed as to maximize short-term or long-term self interests (Madison et al., 1980; Gray & Ariss, 1985; Ferris et al., 1989). According to Farrell and Peterson (1982) political behavior in organizations are those activities that are not required as part of one's organizational role but that influence or attempt to influence, the distribution of advantages and disadvantages within the organization.

Knowledge Sharing

Knowledge had become the most important kit for competition and survival under the business climate in 21st century (Ling, 2003). While traditional economies used to rely on tangible assets such as land and capital, today's economy has evolved to treat knowledge as the primary production factor on which competitive advantage rests (Beijerse, 1999). Once created, knowledge cannot be imitated or substituted, which makes it a key strategic asset resource to all

businesses (Cabrera and Cabrera, 2002).The growing use of knowledge in businesses contributed to the emergence of the theory of knowledge management (Aranda and Fernandez, 2002), which is currently one of the hottest topics in information technology and management literature. Knowledge management is aimed to enhance organizational competence and allow adequate people with adequate information technology at right time. As the complicated features of current business environment had increased rapidly, how to exert the capabilities of knowledge management to enhance organizational competence is exactly the critical crisis we have to face now (Liao, 2003).

Knowledge can be defined as a combination of experience, values, contextual information and expert insight that help evaluate and incorporate new experience and information (Gammelgaard and Ritter, 2000). Knowledge exists in documents and repositories, as well it becomes embedded in people's minds overtime and it is demonstrated through their actions and behaviors. The process of knowledge management involves several activities. The most commonly discussed activity in the process of knowledge management is knowledge transfer (knowledge sharing) (Ford, 2001). Knowledge sharing is critical to a firm's success (Davenport and Prusak, 1998) as it leads to faster knowledge deployment to portions of the organization that can greatly benefit from it (Syed-Ikhsan and Rowland, 2004). Traditional knowledge management emphasis was placed on technology or the ability to build systems that efficiently process and leverage knowledge. In order to make knowledge sharing happen within and among organizations, several researchers have focused on the study of different mechanisms and initiatives which could act as facilitators such as information and communication technologies (Dalkir, 2005; Davenport, 2007), whereas in other cases, personal interaction between individuals is the key (i.e. "people-focused" knowledge management) (Wiig, 2004). But later it was realized that the effectiveness of the system is affected more by its users which led to the new model of knowledge management which involves people and actions. It aims at creating an environment where employees are willing to share knowledge rather than hoarding it. Knowledge transfer requires that an individual or a group cooperate with others to share knowledge and achieve mutual benefits (Syed-Ikhsan and Rowland, 2004; Al-Alawi, 2005). By interacting and sharing tacit and explicit knowledge with others, the individual enhances the capacity to define a situation or problem, and apply his or her knowledge so as to act and specifically solve the problem (Nonaka *et al.,* 2006). Trustworthiness and mutual understanding constitute the basis for higher approachability and improved communication, and therefore for more intensive knowledge sharing (Andrews & Delahaye, 2000; Coleman, 1988; Empson, 2001; Husted & Michailova, 2002; McEvily et al., 2003; Newell & Swan, 2000). Moreover, greater commitment to organizational goals is seen as stimulating the sharing of knowledge that helps in achieving these goals (Leana & Van Buren, 1999).

However, there are many factors in organization which inhibit knowledge sharing and organizational politics, considered to be unavoidable reality in organization, which may hinder knowledge sharing. Politics consumes time, restricts information sharing, and creates communication barriers (Eisenhardt and Bourgeois, 1988). High levels of politics may inhibit knowledge sharing in several ways. First, environments perceived as political may be interpreted as inequitable, resulting in employees feeling that there has been a violation of the 'social contract' between the employer and employee (Cropanzano, Howes, Grandey, & Toth, 1997). The social contract is a mixture of economic and social exchanges (Organ & Konovsky, 1989),

and perceptions of politics impact both of these exchanges. When others receive personal benefits from what is perceived as successfully employed political tactics aimed at building social networks, individuals may view the outcome as unfair (Ferris, Frink, Beehr, & Gilmore, 1995) and feel distrustful of both the political actor and the person rewarding the actor's behavior.

Further, individuals in situations perceived as political may engage in self management behavioral. They may inhibit the development of effective social relationships. In contexts that are perceived as highly political, people are unlikely to want to go out of their way to help others by sharing knowledge, as any energy that they dedicate to others may be perceived as taking away from their efforts to promote self-interests. If employees stop interacting with each other, the organization may not be as efficient as it would be if the workers communicated fully with one another. This potentially negative organizational outcome is consistent with theory and research that has demonstrated a negative relationship exists between perceptions of politics and a variety of organizational outcomes (Kacmar & Baron, 1999).

The present research suggests that employee propensity to engage in knowledge sharing behaviors is strongly influenced by the organizational context. If the organization is highly political in nature, individuals are likely to engage in self-promotional activities. Therefore, a highly charged political context is argued to inhibit the display of knowledge sharing behaviors.

Work Engagement

Engaged workers are energetic, are positively connected to their work and feel they are doing their jobs effectively (Koyuncu et al, 2006). It is considered to be a persistent and broad affective cognitive state. Schaufeli et al (2002) view it as a positive, fulfilling work related state of mind that is characterized by vigor, dedication and absorption. Vigor implies high level of energy, the willingness to invest energy in one's work and persistent in difficult time. Dedication is characterized by high levels of work involvement and feelings of pride and challenge from one's work and absorption imply deep concentration in one's work the sense that time passes quickly and one is reluctant to leave the work (Schaufeli et al., 2002). It is important to study engagement because it is linked to positive individual and work related outcomes (Maslach et al., 2001). Work engagement has been linked with positive organizational behavior like, optimism, trust and engagement (Kahn, 1992; Leiter, 2005 ; Schaufeli and Bakker, 2004a; Schaufeli et al.,2003). Researchers have examined the impact of different organizational variables on work engagement. In a multi-sample study, Schaufeli and Bakker (2004b) found that job demands (workload, emotional demands) were positively related to burnout, but not to engagement, and job resources (social support, supervisor coaching, feedback) were positively related to engagement and negatively related to burnout. In a study of employees from an insurance company reported that high work demands and high control were associated with higher engagement (Demerouti et al. 2001). Mauno et al. (2005) reported an association of high time pressures with higher levels of engagement. The present study conjecture that the politics in the organization will influence negatively influence the work engagement.

Job Satisfaction

Job satisfaction is probably the most widely studied variable in the area of organizational behavior. It is defined as "the pleasurable emotional state resulting from the appraisal of one's job as achieving or facilitating the achievement of one's job values" (Locke, 1969, p. 316).Studies have reported that organizational politics has negative effect on less job satisfaction (e.g., Cropanzano et al., 1997; Ferris et al., 1989; Kacmar, et al., 1999; Poon, 2002). Job satisfaction is associated with fairness in decisions such as incentives, promotion, salary, and resource allocation. When employees perceive that these decisions are not fair and more influence my organizationally unsanctioned means employees feel dissatisfied. Previous research suggested that in highly political organization, rewards may be tried to relationships, power and other such less objective factors, and not specifically related to work performance (Kacmar and Ferris, 1991). The study hypothesize that work place politics will negatively influence job satisfaction. Further it explore the impact of different dimensions of organizational politics on job satisfaction.

Intention to Quit

Intention to quit refers to employees' thoughts of quitting their present job. While actual quitting behavior is the primary focus of interest to employers and researchers, intention to quit is argued to be a strong surrogate indicator for such behavior.. Intentions to leave may be regarded as the last stage in a sequence of withdrawal cognitions, ranging from thinking of leaving to intending to search for alternative employment (Tett & Meyer, 1993). Heightened levels of organizational political demands have been suggested as being predictive of employees' intention to quit their job (Ferris et al., 1989) and researches indicate that perceived organizational politics is significantly related to turnover intention (e.g. Cropanzano et al., 1997; Poon, 2002; Kacmar et al., 1999; Randall et al., 1999), hence this study also conjecture the negative relationship between organizational politics and intention to quit and examines the impact of different dimensions of organizational politics on intention to quit.

METHOD

Sample and Procedure

To test the proposed research model, we adopted the survey method for data collection. Data were gathered by means of questionnaires that were sent through electronic mail. Overall 300 questionnaires were mailed, and 114 usable questionnaires were received, with a response rate of 34.2 percent. The respondents came from 10 organizations from diverse industries, with Manufacturing, Finance, Computers, Engineering and Telecom etc. The participants were lower (81%) and middle level executives (19%). The average age of executives was 26.75 years (SD = 4.06), average experience 3.94 years (SD = 3.38), average experience in current organisation 2.34 years (SD = 3.38), and average experience in present position 2.22 years (SD = 1.37). With respect to the level of qualifications, 72.8 percent were graduates from various streams, (i.e., commerce, science, computers, arts, management, electrical, textile etc); and 27.2% were post-graduates from management, science etc. Male respondents accounted for 79.8 percent of the population and 20.2 percent were the females. Married respondents were 25.4 percent and 74.6 percent accounted for unmarried respondents.

Measures

Knowledge sharing behavior.

It was measured using four items adapted from the work of Lee (2001). Employees were asked to respond how frequently they share their knowledge with others in organizations on 5-point scale (1- very rarely, 5 very frequently). The coefficient alpha for the scale was .67.

Perceptions of Politics

Perceptions of organizational politics were measured with instrument developed by Ferris and Kacman (1992). It is 31-item measure that examined various aspects of political behavior in organizations. Employees responded on 5-point likert scale the extent to which they agreed with each statement as it reflected their present work environment (1 – strongly disagree, 5 – strongly agree). The coefficient alpha for the aggregate measure of politics perceptions was .81

Work engagement

It was measured using scales developed by Schaufeli et al. (2002), and Schaufeli and Bakker (2004a). It included three aspects of work engagement, namely vigor (6 items), dedication (5 items), and absorption (6 items). Respondents indicated their agreement with each item on five-point Likert scale (1 – Strongly disagree; 5 – Strongly agree). The scale has high reliability coefficient (alpha) of .87.

Job Satisfaction

It was measured with four items (e.g., "I find real enjoyment in work"). Respondents indicated their levels of satisfaction indicating the degree of agreement with these items on five- point Likert scale (1- strongly disagree; 5 – strongly agree). The scale showed a reliability coefficient of .69.

Intention to quit

It was measured by three items (e.g., "I think a lot about quitting my job"). Subjects indicated their agreement on five point scale (1 – Strongly disagree; 5 – Strongly agree). The scale has reliability coefficient (alpha) of .92.

Analysis

Data were analyzed using descriptive and inferential statistical techniques. For organizational politics questionnaire factor analyses was done. Later the descriptive statistics, correlations and reliability coefficients were computed for each measure. Hypotheses were tested using regression analysis.

RESULTS

Factor Analyses

Before conducting factor analyses, sampling adequacy test was computed using Kaiser-Meyer-Olkin (KMO) statistic. All the items were found to have KMO value higher than .60. The KMO statistics for the sample data set was .69 and Bartlett test showed that nonzero correlations existed at the 0.000 significance level.

Thirty-one items of perceptions of politics were subjected to item analysis. Based on item analysis 16 items were selected for further analysis. These sixteen items were subjected to principal components analysis with varimax rotation. Five factors emerged with eigen values greater than 1.0 and these factors explained 62.45% of variance.

Two rules were used to select items that best represent each of the factors. First, all selected items had to have a factor loading greater than 0.50, the point at which loadings are considered to be practically significant (Hair et al. 2006). Second, items had to clearly load on one factor; items with similar loadings on both factors were not included. Because all items loaded above 0.50 on their intended factor and had relatively low cross-loading, there is evidence of factorial validity for the measure used. The first factor was named as "supervisor behaviour", factor 2 as "co-worker and clique behaviour", factor 3 as "go along to get ahead" and factor 4 as "organization practices and policies". Factor five had only one item so it was not used for further analysis. The cronbach alpha reliability were 0.80 for factor 1, 0.70 for factor 2, 0.60 for factor 3 and 0.59 for factor 4.

Descriptive Statistics

The means and standard deviations for all variables are presented in Table 2. The correlations among study variables are reported in Table 3.

Table 1 : Factor loadings for Perceptions of Politics Questionnaire

Items		Fcator 1	Factor 2	Factor 3	Factor 4
S1item1	Favoritism rather than merit determines who gets ahead around here.	.641	.222	.209	.004
item14	When my supervisor communicates with me, it is to make himself/herself look better, not to help me.	.561	.051	.022	.176
item20	I have seen people deliberately distort information requested by others for purposes of personal gain, either by withholding it or by selectively reporting it.	.522	.187	.330	.183
item24	The rules and policies concerning promotion and pay are fair, it is how supervisors carry out the policies that is	.806	-.053	-.118	-.287

Items		Fcator 1	Factor 2	Factor 3	Factor 4
	unfair and self-serving.				
item27	Whereas a lot of what my supervisor does around here (e.g., communicates and gives feedback, etc.) appears to be directed at helping employees, it is actually intended to protect himself/herself.	.737	.294	.190	.167
item28	The performance appraisals/ratings people receive from their supervisors reflect more of the supervisor's "own agenda" (e.g., likes and dislikes, giving high or low ratings to make themselves look good etc.) than the actual performance of the employee.	.698	.189	.376	-.137
item5	There are "cliques" or "in-groups" which hinder the effectiveness around here.	.362	.581	.201	-.096
item13	As long as the actions of others don't directly affect me, I don't care what they do.	.000	.730	-.103	.104
item21	Managers in this organization often use the selection system to hire only people that can help them in their future or who see things the way they do	.184	.693	.069	-.036
item22	I have seen changes made in policies here that only serve the purposes of few individuals, not the work unit or the organization.	.143	.605	.178	-.259
item9	There has always been an influential group in this department that no one ever crosses.	.083	.270	.784	-.216
item10	Generally, people who have left this organization did so because they realized that just working hard was not enough to get ahead.	.224	-.153	.724	.193
item3	You can get along here by being a good guy, regardless of the quality of your work.	.162	.127	-.096	.795
item30	Pay and promotion policies are generally communicated in this company.	-.155	-.239	.130	.720
Percentage of Variance		29.05%	10.61%	8.62%	7.56%

Items		Fcator 1	Factor 2	Factor 3	Factor 4
Reliability Coefficient		.80	.70	.60	.59

Table 2 Mean and Standard Deviations for Variables of Study

Variables	Mean	Std. Deviation
supervisor behaviour	2.72	.79
co-worker and clique behaviour	3.07	.78
go along to get ahead	2.85	.93
organization practices and policies	2.47	.82
Work engagement	3.61	.51
Knowledge Sharing	4.05	.38
satisfaction	3.73	.63
Intention to quit	2.28	.88

Table 3 Correlations among Study Variables

	Variables	1	2	3	4	5	6	7	8
1	Work engagement								
2	Knowledge sharing	.35(**)							
3	Satisfaction	.73(**)	.35(**)						
4	Intention to quit	-.35(**)	-.064	-.46(**)					
5	supervisor behaviour	.074	.087	-.19(*)	.34(**)				
6	co-worker and clique behaviour	.19(*)	.075	.115	.169	.45(**)			
7	go along to get ahead	.015	.160	-.19(*)	.28(**)	.40(**)	.27(**)		
8	organization practices and policies	-.30(**)	-.160	-.26(**)	.058	.013	-.144	-.023	

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Regression Analysis

Multiple regression analysis was used to test the relationships between employees' perception of politics and employees' behavior and attitude toward work and organization.

The results of regression analysis for employees' perception of work place politics and employees' knowledge sharing behavior were not significant implying that knowledge sharing is not influenced by employees' perception of politics in organization.
The results of regression analysis for employees' perception of work place politics and work engagement significantly support the overall model with F value of 3.50 ($p < .010$) (Table 4). Adjusted R square (.08) indicates that the variance in work engagement is substantially explained by employees' perceptions of politics. Among the four dimensions of politics, organization practices and policies ($\beta = -.281$, $p < .003$), has significant negative effect on work engagement of employees. Other dimensions of politics were found to be unrelated to work engagement.

Table 4: Results of Regression Analysis for Work Engagement as Dependent Variable and perception of politics as Independent Variables

	Sum of squares	Degrees of Freedom	Mean Squares		
Regression	3.38	4	.85	3.50	.010(a)
Residual	26.29	109	.24		
Total	29.67	113			
=.11; Adjusted R-Square = .08					
	Standardized coefficient				
supervisor behaviour	.028	.265	.792		
co-worker and clique behaviour	.147	1.427	.157		
go along to get ahead	-.043	-.435	.665		
organization practices and policies	-.281	-3.074	.003		

The results of regression analysis for employees' perception of work place politics and satisfaction significantly support the overall model with F value of 5.27 ($p < .001$) (Table 5). Adjusted R square (.13) indicates that the variance in satisfaction is substantially explained by employees' perceptions of politics. Among the four dimensions of politics, three dimensions of perception of politics namely supervisor behavior ($\beta = -.223$,$p < .034$), co-worker and clique behavior ($\beta = -.23$,$p < .024$), and organization practices and policies ($\beta = -.230$,$p < .011$), have significant effect on satisfaction of employees.

Table 5: Results of Regression Analysis for Satisfaction as Dependent Variable and perception of politics as Independent Variables

	Sum of squares	Degrees of Freedom	Mean Squares		
Regression	7.17	4	1.79	5.27	.001
Residual	37.06	109	.34		
Total	44.23	113			
=.16; Adjusted R-Square = .13					
	Standardized coefficient				
supervisor behaviour	-.223	-2.148	.034		
co-worker and clique behaviour	.229	2.285	.024		
go along to get ahead	-.171	-1.784	.077		
organization practices and policies	-.230	-2.587	.011		

Table 6: Results of Regression Analysis for Intention to quit as Dependent Variable and perception of politics as Independent Variables

	Sum of squares	Degrees of Freedom	Mean Squares		
Regression	12.23	4	3.06	4.46	.002
Residual	74.72	109	.69		
Total	86.956	113			
=.14; Adjusted R-Square = .11					
	Standardized coefficient				
supervisor behaviour	.267	2.533	.013		
co-worker and clique behaviour	.013	.127	.899		
go along to get ahead	.164	1.689	.094		
organization practices and policies	.060	.666	.507		

The results of regression analysis for employees' perception of work place politics and intention to quit significantly support the overall model with F value of 4.46 ($p < .002$) (Table 6). Adjusted R square(.11) indicates that the variance in intention to quit is substantially explained by employees' perceptions of politics. Among the four dimensions of politics, supervisor behavior

(β = .267, p <.013) has significant positive effect on satisfaction of employees. Other dimensions of politics were found to be unrelated to intention to quit.

DISCUSSION

Everyone in the organization work to achieve certain objectives. These objectives may be concrete such as incentives, promotion etc or abstract such as status attainment etc. In the process of achieving these goals, employees in the organization may engage in political behavior to protect or enhance their own interests, particularly as when face scare resources and increasing competition. Given the fact that organizational politics is inevitable reality of workplaces, it becomes necessary how employees perceive politics in organizations and different dimensions of organizational politics. If employees perceive a highly political organizational atmosphere, all behavior in the organization will be interpreted in that light. The perceptions individual have about the political nature of their work environment will influence the way they do their jobs and affect how they feel about their organization, senior and co-workers.

The present study was in an attempt in this direction. It examined the organizational politics in culture characterized by high power distance and high on collectivism. This study found the perceptions of organizational politics include four factors namely, "Supervisor behavior", "Co-worker and clique behavior", "Organizational practices and policies", and "Go along to get ahead". The first there factors were found to related to employees' behavior and attitudes. "Organizational practices and policies" dimension was negatively related to work engagement. Employees' job satisfaction is negatively influenced by Supervisor behavior, co-worker and clique behavior and organization practices and policies. Supervisor behavior significantly influences intention to quit. These findings are in congruence with the findings of earlier studies examining the influence of organizational politics on employees' work attitudes and behaviors (e.g. Farris et.al 1989).

Knowledge sharing behavior was found to be unrelated to the perception of politics in organization. The reason of knowledge sharing unrelated to perception of politics may be the level of respondents in organization. Most of the participants of the study belonged to lower levels where politics is less compared to higher level. Other explanation may be employees have more reasons to share knowledge rather than not to share it. Today's' organization motivate the employees with various systems and process like knowledge sharing portals, incentive programs and recognition etc.

In the study respondents reported low politics in their organization as mean score on all the dimensions is less than 3.50. The reason of low score on politics may be that most of the employees belong to lower level in organization, where employees are more involve in technical work related to their function and do more individual task and less dependent on other employees. Rewards are more based on individual performance and more based on explicit outcomes. As the employees moves up in the hierarchy they are more interdependent and resources become scare. Organizations are like pyramid where positions are lesser compare to lower levels. Employees are higher level are more involve in planning and job become more unstructured unlike lower level. Studies have indicated that politics as more prevalent among

higher and middle managerial levels than among lower and non-managerial levels (Farris et al., 1989; Fandit and Ferris, 1990; Gandz and Murray, 1980).

There are some limitations in our research that should be mentioned. The sample size was not large enough therefore, the study needs to be replicated using a larger sample of employees. This research has only collected cross-sectional data, and it is not appropriate to infer strong causal relationships between variables. Collecting longitudinal data may be a better approach for future research. Another limitation is the use of self-reported measures when employees provided data on both independent and dependent variables. It is possible that the relationships among the independent and dependent variables were inflated due to common method variance. Further, in the present study most of the respondents were from lower levels. Future study need to include respondents from middle and higher levels also and re-examine the relationship between perception of organizational politics and knowledge sharing in organizations. Studying the organizational politics across level will help to understand differences in perceptions of employees. It will help to managers to identify which dimensions of organizational politics influence employees' attitude and behaviour, so corrective measures can be taken to minimize the negative impact of organizational politics. Managers can put more efforts into streamlining the communication channels, inspiring participation of employees, effectively linking the rewards with performance, and using fair decision-making procedures in work place.

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THE EFFECT OF DIVERSIFICATIONS ON THE PERFORMANCE AND RISKS OF BANKS AND CREDIT UNIONS IN TAIWAN

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Chi-An Wang, National Taipei University of Technology, Taiwan
Spiceandy84@hotmail.com

ABSTRACT

Due to the competitiveness become more serious than ever in financial industry, financial organizations are doing more and more diversification to earn more operating income. But different studies and researches usually came out vary results. This study examines the banks and credit unions, two important types of financial organizations in Taiwan's economy, doing diversification would give what kind of impact to their financial performance and risk. We choose 36 banks and 27 credit unions in Taiwan and collect 4-year period data from 2005 to 2008. There are two different diversification variables- Herfindahl-Hirschman index and Non-interest income to operating income ratio. Then we use Hansen's (1999) Panel Threshold Regression Model to test if there are thresholds when financial organizations do diversifications. We find when banks and credit unions do more diversification it would influence their Risk-adjusted rate of ROE and Z-score significantly. So making decisions of doing diversifications becomes a very important idea for management of banks and credit unions. The findings can help researchers to understand that different types of financial institutions may optimally choose different degrees of diversification, which sheds some light on the inconsistent findings in the literature regarding the relationship between diversification and firm values.

Keywords: Diversification, Panel Threshold Regression Model, Non-interest Income, Performance, Insolvent Risk

INTRODUCTION

For the recent decades in Taiwan, financial industry, which includes banks and credit unions, has always been playing a very important role in the economic development. Banks and credit unions are the intermediate organizations that bring money borrowers and lenders together. And the traditional income sources of these two financial corporations are the interest income. After the government adopted the policy of liberalization and internationalization in the recent years, financial industry of Taiwan has undertaken several impacts. The most important one is the number of financial corporations boosted significantly.

Because of that, the environment has become more competitive than ever.

The serious problem of the financial environment has existed for years. Banks and credit unions in Taiwan then reduce their lending interest rates and enhance saving interest rates in order to strengthen themselves and take up more customers. But that will lead to the consequences of decreased income. Because the profit decreased and the risk rose, banks and credit unions try to diversify their scope of products and services, and to use information technology to create various earning sources. Via diversification, they expect to discover wider range of businesses and to achieve the scope economy.

Commercial banks offer many financial products and services, such as, credit card, cash card, trust fund, derivative financial products, securitization financial products, financial planning services, etc., to make their income sources vary. On the other hand, credit unions in Taiwan usually provide simple business services such as lending money to household unit and small and medium enterprises. As the competition arises, they also perform certain diversifications, such as the credit card of the National Federation of Credit Unions and the insurance services.

The diversification of banks and credit unions means that they not only do their traditional interest-earning activities, but also bring out more non-interest activities to earn non-interest income. So we take the ratio of non-interest income to total income as the proxy variable to measure the degree of diversification. When the non-interest income increases, the degree of diversification increases as well. Moreover, Herfindahl-Hirschman Index (HHI), which is a common used diversification ratio, also gives people sign to know whether the degree of banks and credit unions diversification is high or low. Here HHI is also calculated by the non-interest income. So non-interest income is a very important element for us to measure the diversification.

Should banks and credit unions diversify their portfolios across different industries or even broader economic sectors and geographical regions, or should they focus on a few related fields? The focus versus diversification issue is important in the context of banks and credit unions as they are affected by several regulations that create incentives either to diversify or to focus their portfolios, i.e. the imposition of capital requirements tied to the risk of the banks and credit unions' assets or asset investment restrictions. Hence, policymakers should be especially interested to see whether or not banks benefit from diversification.

As long as banks and credit unions earn more from the non-interest income, it is always interesting to know whether diversifications would have a positive or negative influence on their revenue and risks. In recent years, some researches of banking diversification came out

with different conclusions. And there has been little study regarding the diversification effect on the credit unions in Taiwan. The purpose of this study is to examine the diversification effect on the performance and risks of banks and credit unions respectively. Then we compare the difference between these two parties, and give suggestions and conclusions.

The remainder of the paper is organized as follows. Section 2 reviews the prior literature and Section 3 explains describes the dataset, variables, and the methodology that we adopted. We present empirical results in Section 4 and offer concluding remarks in Section 5.

LITERATURE REVIEWS

Diversification in banks and credit unions can be viewed as three-dimensional: across financial products and services; through geographic expansions, and through a combination of geographic and business line diversification. Nevertheless, the concept of financial organizations is still the same. Studies of cross-functional mergers provide mixed results.

From a theoretical standpoint, the decision to diversify income sources is desirable for both efficiency and risk management. The joint production of a wide range of financial services should increase a bank's efficiency (Klein and Saidenberg 1997). Thus, generally speaking, diversification across new types of services should enhance profitability.

When researchers consider risk, it is generally believed that diversification of income sources—that is, the shift from interest to non-interest income—should reduce total risk. Here, the idea is simple: since activities that generate non-interest income are thought of as uncorrelated, or, at least, imperfectly correlated, with those that produce interest income, diversification should stabilize operating income and give rise to a more stable stream of profits.

Empirical research has examined the issue of diversification benefits from several standpoints and through different methodological approaches. In spite of what economic theory postulates, namely, a positive relation between diversification and profitability, it has produced evidence that is by no means clear cut. An exhaustive survey of the literature on bank product mix and bank risk goes beyond the purpose of this paper (for such a survey see, for instance, DeYoung and Roland 2001). Here, we are interested only reviewing the most recent papers and comparing the findings for the U.S. and the EU. In fact, most of the studies that we review deal with U.S. banks (DeYoung and Roland 2001; Stiroh, 2004; DeYoung and Rice 2004; Stiroh and Rumble 2006), but to the best of our knowledge, only a few papers focus on the experience of European banks (European Central Bank 2000; Smith et al. 2003)

and none of them uses econometric methods.

Stiroh (2004), considering U.S. banking data between 1984 and 2001, finds that in the aggregate, industry-wide level, the correlation between net interest income growth and noninterest income growth increased in the 1990s; moreover, that non-interest income is much more volatile than net interest income, Further, that the lowering of operating revenue volatility, which occurred in the 1990s, can be traced directly to the declining volatility of net interest income. Finally, Stiroh finds that at the bank level, risk-adjusted returns are negatively associated with non-interest income shares.

DeYoung and Rice (2004), using data for U.S. commercial banks between 1989 and 2001, find that marginal increases in non-interest income were associated with higher profits, more variable profits, and on net, a worsening of risk–return trade off.

Stiroh and Rumble (2006), in a study on U.S. financial holding companies for the 1997–2002 period, find that there is no link between diversification and performance, but that there is a large negative relation between non-interest share and performance.

Smith et al. (2003) analyze the variability of interest and non-interest income and their correlation, for the banking systems of the 15 EU countries during the 1994–1998 period. For each country, Smith considers commercial, savings, cooperative, and mortgage banks on the one hand and large and small banks on the other, and study the correlation of income sources. They find that in the majority of the cases, the increased reliance on activities that generate non-interest income has stabilized profits.

Mercieca, Schaeck, and Wolfe(2007) took ROE and ROE to measure the performances of banks, HHI to measure the risk and degree of banks' diversification, Z-score to measure banks' insolvent risks. They research annual data for small European banks for the period 1997–2003 from bank scope and classify small banks as credit institutions with an asset size less than €450 million and no multi-bank affiliation. They find that when non-interest income increases, it doesn't help significantly with the small banks' performances, but with positive influence to large banks' ones.

As far as we are aware, Esho et al.'s (2005) and John Goddard, Donal McKillop, John O.S. Wilson (2007) are the only two empirical investigations of the impact of diversification on the financial performance of credit unions. Within Esho et al.'s research, over the period 1993–2001 an increased reliance on fee income generating activities was associated with increased risk. Credit unions with more highly concentrated income streams tended to have

higher risk and returns. Those with a higher proportion of total income from interest on residential loans, and a lower proportion of income from interest on personal loans, had significantly lower risk and returns. Credit unions that diversified by increasing the share in income of transaction fees on loans and deposits, matched by a reduction in the income share of interest on personal loans, experienced higher risk and lower returns.

And John Goddard, Donal McKillop, John O.S. Wilson (2007) collect the data from National Credit Union Association and Callahan & Associate's 5300 Call Reports between 1993 to 2004. And use the cross-sectional data to do the regression and analysis the financial performances. They adopt 6 indicators, they are ROA, ROE, σ_{ROA}, σ_{ROE}, risk-adjusted ROA(RAR_{ROA}), and risk-adjusted ROE (RAR_{ROE}). The result shows that if the credit unions' portfolio is similar, increasing non-interest income will increase the volatility of returns. And larger credit unions are more benefit from the diversification. Small ones should just focus on what they originally do.

METHODOLOGY

This section discusses the methodology that we apply on this paper. Firstly, it briefly review the building procedure for Panel Threshold Regressions based mainly on Hansen (1999), thereafter turning to the empirical specification.

Panel Threshold Regression Model

Threshold regression models allow individual observations to be divided into regimes based on the value of an observed variable. Firstly introduced into univariate time series context (TONG, 1983), the seminal paper of Hansen (1999) introduced the econometric techniques appropriate for threshold regression with panel data. Allowing for fixed individual-effects the PTR model divides the observations into two or more regimes depending on whether a threshold variable is smaller or larger than a threshold value, and these regimes are distinguished by differing regression slopes.

Hansen (1999) provides a two-regime balanced panel structural equation as follows:

$$y_{it} = \mu_i + \beta_1' x_{it} I(q_{it} \le \gamma) + \beta_2' x_{it} I(q_{it} > \gamma) + e_{it} \quad (2.1)$$

where y is the dependent variable and x is the vector of independent variables. Term is the cross-sectional unit of state, t is the year of observed data, μ_i is the individual-specific means, q_{it} is the threshold variable, and I(.) is the indicator function. This equation can be rewritten as:

$$y_{it} = \mu_i + \beta' x_{it}(\gamma) + e_{it} \quad (2.2)$$

where $\beta = (\beta_1', \beta_2')$ and $x_{it}(\gamma) = \begin{bmatrix} x_{it} I(q_{it} \le \gamma) \\ x_{it} I(q_{it} > \gamma) \end{bmatrix}$ (2.3)

Let Y, X, and denote the data stacked over all individuals:

$$Y^* = X^*(\gamma)\beta + e^* \quad (2.4)$$

and the coefficient β estimated by OLS:

$$\hat{\beta}(\gamma) = (X^*(\gamma)' X^*(\gamma))^{-1} X^*(\gamma) Y^*$$

and the sum of squared error (SSE) is:

$$S_1(\gamma) = \hat{e}^*(\gamma)' \hat{e}^*(\gamma)$$

$$= Y^{*'} \left(I - X^*(\gamma)(X^*(\gamma)' X^*(\gamma))^{-1} X^*(\gamma)' \right) Y^*$$

where

$$\hat{e}^*(\gamma) = Y^* - X^*(\gamma)\hat{\beta}(\gamma)$$

It is important to determine whether the threshold effect is statistically significant. The null hypothesis of no threshold effect (linearity) is:

$$H_0 : \beta_1 = \beta_2$$

Rejecting implies that there is one threshold at least. Hansen (1999) suggests the F test is:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2} \quad (2.5)$$

where S_0 is the SSE obtained from the estimative of (2.1) under the null hypothesis of no threshold, S_1 is the SSE obtained from the PTR estimative of (2.1), and $\hat{\sigma}^2$ is the residual variance of the PTR regression.

It is possible that the model includes more than one threshold. We first employ the F_1 test to assess the null hypothesis. If this null hypothesis is rejected, then at least one threshold is ensured. We then continue testing the null of one threshold against the alternative of two thresholds – that is:

$$F_2 = \frac{S_1(\hat{\gamma}_1) - S_2^r(\hat{\gamma}_2^r)}{\hat{\sigma}^2} \quad (2.6)$$

where γ_2 is the second threshold. A significant F_2 implies the rejection of the null of one threshold. Therefore, we can repeat this procedure to test the null of more thresholds. The critical values are computed based on the bootstrapping method. If the model exists with a threshold effect, then the next step is estimating the threshold value $\hat{\gamma}$. Hansen (1999) provides a method to form an asymptotic confidence interval for $\hat{\gamma}$ which is to form the no-rejection region $c(\alpha)$:

$$LR_1(\gamma) = \frac{S_1(\gamma^*) - S_1(\hat{\gamma})}{\hat{\sigma}^2} \tag{2.7}$$

$$c(\alpha) = -2\log(1-\sqrt{1-\alpha})$$

where $S_1(\gamma^*)$ and $S_1(\hat{\gamma})$ are the residual sum of squares given the true threshold γ* and $\hat{\gamma}$ estimated, and $(1-\alpha)$ is the set of values of γ such that $LR_1^r(\gamma) \le c(\alpha)$, respectively. If two thresholds cannot be rejected, the confidence intervals can be set in the same way:

$$LR_2^r(\gamma) = \frac{S_2^r(\gamma) - S_2^r(\hat{\gamma}_2^r)}{\hat{\sigma}^2} \tag{2.8}$$

where $S_2^r(\hat{\gamma}_2^r)$ is defined in (2.6).

Sample Selection and Data

We use financial data from Taiwan Economic Journal, and Market Observation Post System database of regional banks and credit unions in Taiwan. The samples used in this study are the 36 banks and 27 credit unions in Taiwan from 2005 to 2008. Those banks are selected because they have the complete 4 period data for 4 years. So we exclude some banks those don't have complete data. Beside that, the credit unions in Taiwan are all selected. We use annual data so there are 252 data.

Variables

Dependent Variables: Risk-adjusted rate of ROE, Z-score

(1) Performance Variable: Risk-adjusted rate of ROE (RAR_{ROE})
ROE is mean value of return on equity. It is the ratio of net income (after loan-loss provisions) to net worth or capital, defined as the sum of reserves, undivided earnings, loan and investment loss provisions, accumulated unrealized gains on securities and uninsured secured capital. For each bank and credit union, we calculate the average ROE over the quarters in a bank or credit union's lifetime or a given year. For each bank and credit union, we also calculate the standard deviation of σ_{ROE} over the same lifetime or year to measure the total volatility of profits. These variables define risk-adjusted return on equity, RAR_{ROE}. The equation is as follows:

$$RAR_{ROE} = \frac{ROE}{\sigma_{ROE}}$$

(2) Risk Variable: Z-score

Z-score is used to measure risks in this study due to that learning the insolvent possibility when banks and credit unions take diversification activities is crucial for investors. Take the year 2008 as an example, a large proportion of financial crises and bankruptcies arose from those companies that took too much financial leverage activities. And financial leverage activity is similar to diversification activity in some aspect. So we take Z-score to measure the risk of banks and credit unions.

The regulator may not care about the actual level of risk but put their eyes on a bank's distance to default. It's a potential criticism of an asset return volatility risk which is usually used to measure a bank's bankruptcy probability (Bouwman, 2004). How closer to failure is generally measured by an index which is called Z-score, introduced by Altman (1968). The Z-score estimates the number of standard deviations below the mean by which profits would have to fall before equity becomes negative. Boyd and Graham (1986) adopt the following equation to examine the risk of failure at large BHCs that diversified into non-banking activities during the 1970s and early 1980s,

$$Z_i = \left(\left\{\sum_{j=1}^{n}\left[2\pi_j/\left(A_j + A_{j-1}\right)\right]\right\}/n + \left\{\sum_{j=1}^{n}\left[\left(E_j + E_{j-1}\right)/\left(A_j + A_{j-1}\right)\right]\right\}/n\right)/S_r$$

where π is net income after taxes, A is total assets, E is total equity, Sr is the standard deviation of π/A, and the subscript j denotes the time period. High values of Z-score are associated with low probabilities of failure and the Z-score approach is frequently used in banking studies.

Threshold Variable: DIV

Both of Threshold Variable that we use the same variable to analyze the degree of diversification is because we want to know at what certain level of diversification will influence our dependent variables. We define Threshold Variable as DIV. And the DIV variable can be two as follow:

(1) Herfindahl-Hirschman index (DIV_{HHI})

The early studies on non-financial industries diversification were based on SIC codes with segmental accounting data. But the degree measurement of SIC-code classification for banks is not granular enough and is not consistent across countries. Moreover, segmental reporting is not consistent across banks and across time (Elsas, Hackethal, Holzhäuser, 2006) Instead, we use an adjusted Herfindahl-Hirschman index to measure revenue diversification. Various authors have applied a similar measuring method (see, e.g., Acharya et al. 2002; Stiroh & Rumble 2003; Stiroh 2004). Equation below shows how this study constructed the

diversification index.

$$HHI_i = 1 - \left(\left(\frac{INT}{TOR} \right)^2 + \left(\frac{COM}{TOR} \right)^2 + \left(\frac{TRAD}{TOR} \right)^2 + \left(\frac{OTI}{TOR} \right)^2 \right)$$

The variable definitions are as follows: INT denotes gross interest revenue, COM denotes net commission revenue, TRAD denotes net trading revenue, OTI denotes all other net revenue and TOR denotes total operating revenue. Denominator TOR is equal to the sum of the absolute values of INT, COM, TRAD and OTI, and we use gross interest revenue so that our diversification measure is not unduly distorted by the profitability of the bank's interest business. We use accounting data from the TEJ database which consistently reports gross numbers for the other revenue categories.

We subtract the sum of squared revenue shares from unity so that HHI increases in the degree of revenue diversification, the higher values of HHI, mentioning the degree of diversification is much higher. By definition HHI can take on values between zero (the bank and credit union is fully specialized in only one business areas) and 0.75 (the bank and credit union generates a fully balanced revenue mix from all four business areas).

(2) Non-interest income to operating income ratio (DIV_{NIOIR})

This is a simple way to measure the degree of diversification that banks and credit unions take. Adopting this ratio basically let us see through the characteristics of bank and credit union industry. Banks and credit unions are the intermediate organizations that bring money borrowers and lenders together. So the traditional income sources of these two financial corporations are the interest income. When banks and credit unions do more non-interest activities, they will have more non-interest income. The equation of calculating the Non-interest income to total income ratio is as follows:

$$DIV_{NIOIR} = \frac{Operating\,Income - Interest\,Income}{Operating\,Income}$$

Operating income of banks and credit unions can easily separate into two major elements: interest income and non interesting income. When non-interest income arises, that means this organization take more actions on diversification.

Other Variables

We put ten variables in our panel threshold regression model in order to analyze the relationship between other variables and the dependent variables. Those variables are collected from the annual financial reports of banks and credit unions in Taiwan. And the ten other variables are: overdue loan rate(OLR), liability to net value ratio(LN), loan growth

ratio(LGR), operating expense to operating income ratio(EIR), equity to asset ratio(EAR), branch number(BN), asset scale(AS), allowance for uncollectible accounts to overdue loan ratio(AOR), capital ratio(CR), and loan ratio(LR).

Empirical Model

When defined all of the variables, we construct the panel threshold regression model as bellow equation:

$$ROE_{it} = \mu_i + \beta_1 DIV_{it-1} I(DIV_{it-1} \le \gamma_1) + \beta_2 DIV_{it-1} I(DIV_{it-1} > \gamma_1) + \theta_1 OLR_{it-1} + \theta_2 LNR_{it-1} + \theta_3 LGR_{it-1} + \theta_4 EIR_{it-1} + \theta_5 LR_{it-1} + e_{it-1} \quad (2.9)$$

$$Z_{it} = \mu_i + \beta_3 DIV_{it-1} I(DIV_{it-1} \le \gamma_2) + \beta_4 DIV_{it-1} I(DIV_{it-1} > \gamma_2) + \theta_6 BN_{it-1} + \theta_7 AS_{it-1} + \theta_8 OLR_{it-1} + \theta_9 LNR_{it-1} + \theta_{10} AOR_{it-1} + \theta_{11} CR_{it-1} + e_{it-1} \quad (2.10)$$

The DIV variable here can be DIV_{HHI} and DIV_{NIOIR} respectively. When the primary models are constructed, we use GAUSS program and use the bootstrap 300 times, in order to get the F-Statistics and p-value. If the p-value is less than 5%, we continue to do the double threshold test. The models are as follows:

$$ROE_{it} = \mu_i + \beta_1 DIV_{it-1} I(DIV_{it-1} \le \gamma_1) + \beta_2 DIV_{it-1} I(\gamma_1 < DIV_{it-1} \le \gamma_3) + \beta_3 DIV_{it-1} I(\gamma_3 < DIV_{it-1}) + \theta_1 OLR_{it-1} + \theta_2 LNR_{it-1} + \theta_3 LGR_{it-1} + \theta_4 EIR_{it-1} + \theta_5 LR_{it-1} + e_{it-1} \quad (2.11)$$

$$Z_{it} = \mu_i + \beta_3 DIV_{it-1} I(DIV_{it-1} \le \gamma_2) + \beta_4 DIV_{it-1} I(\gamma_2 < DIV_{it-1} \le \gamma_4) + \beta_3 DIV_{it-1} I(\gamma_4 < DIV_{it-1}) + \theta_6 BN_{it-1} + \theta_7 AS_{it-1} + \theta_8 OLR_{it-1} + \theta_9 LNR_{it-1} + \theta_{10} AOR_{it-1} + \theta_{11} CR_{it-1} + e_{it-1} \quad (2.12)$$

EMPIRICAL RESULTS

We must examine the number of threshold for equation (2.9) and (2.10) to check if banks and credit unions do diversification could bring what influence to their financial performances and risks. If the single threshold effect exists, we continue to examine equation (2.11) and (2.12) to find the double threshold effect. We have two dependent variables-RAR_{ROE}, Z-score; two diversification variables-DIV_{HHI}, DIV_{NIOIR}. So there will be four threshold testing combinations: (1) RAR_{ROE}, DIV_{HHI}; (2) RAR_{ROE}, DIV_{NIOIR}; (3) Z-score, DIV_{HHI}; (4) Z-score, DIV_{NIOIR}.

Table 1, 2, 3, 4 show the results and the bootstrapped critical values for single, double, and triple threshold effects for the four threshold testing combinations respectively. Through 300

bootstrap replications for each of three bootstrap tests, we find the tests for single threshold F_1 almost all are significant with bootstrap p-value0.0200, 0.0133, 0.1400, and 0.0467. The tests for double threshold F_2 are all statistically significant with p-value of 0.0300, 0.004, 0.0033, and 0.0400. And the tests for a triple threshold F_3 are insignificant with p-value of 0.9033, 0.9267, 0.9667, and 0.9833. Statistics F_1 and F_2 exceed the critical values at the 5% significant level, but is smaller than the critical value at the 10% significant level.

Table 1

Tests for Threshold Effects- RAR_{ROE}, DIV_{HHI}

Test for Single Threshold	
F_1	18.938326
P-Value	0.0200**
(10%, 5%, 1% critical values)	(13.018432, 15.528865, 20.245525)
Test for Double Threshold	
F_2	19.997362
P-Value	0.0300**
(10%, 5%, 1% critical values)	(13.433144, 16.094187, 23.642480)
Test for Triple Threshold	
F_3	3.3939502
P-Value	0.9033
(10%, 5%, 1% critical values)	(13.799717, 18.517817, 29.689262)

Note: ** indicates statistical significance at 5%.

Table 2

Tests for Threshold Effects- RAR_{ROE}, DIV_{NIOIR}

Test for Single Threshold	
F_1	22.980451
P-Value	0.0133**
(10%, 5%, 1% critical values)	(13.133243, 15.875910, 23.559242)
Test for Double Threshold	
F_2	16.041866
P-Value	0.004**
(10%, 5%, 1% critical values)	(13.233615, 15.187974, 21.847831)
Test for Triple Threshold	
F_3	3.2433529
P-Value	0.9267
(10%, 5%, 1% critical values)	(11.968392, 14.503536, 23.954398)

Note: ** indicates statistical significance at 5%.

Table 3

Tests for Threshold Effects- Z-score, DIV_{HHI}

Test for Single Threshold	
F_1	11.064261
P-Value	0.1400
(10%, 5%, 1% critical values)	(12.302305, 14.912992, 19.911903)
Test for Double Threshold	
F_2	18.679722
P-Value	0.0033**
(10%, 5%, 1% critical values)	(12.123252, 14.314477, 16.311188)
Test for Triple Threshold	
F_3	2.7724506
P-Value	0.9667
(10%, 5%, 1% critical values)	(14.824632, 22.450637, 45.231634)

Note: ** indicates statistical significance at 5%.

Table 4

Tests for Threshold Effects- Z-score, DIV_{NIOIR}

Test for Single Threshold	
F_1	14.027480
P-Value	0.0467**
(10%, 5%, 1% critical values)	(11.695873, 13.624405, 19.460986)
Test for Double Threshold	
F_2	14.400398
P-Value	0.0400**
(10%, 5%, 1% critical values)	(12.154482, 13.843604, 17.382107)
Test for Triple Threshold	
F_3	2.3471374
P-Value	0.9833
(10%, 5%, 1% critical values)	(12.443612, 15.572665, 21.282345)

Note: ** indicates statistical significance at 5%.

As can be seen, the threshold model (2.9) and (2.10) have three regimes, suggesting the possibility of two thresholds. We next examine the threshold values after confirming the threshold effect. Table 5, 6, 7, and 8 show the estimated two threshold values for the four threshold testing combinations respectively. These minor confidence intervals show the efficiency of estimation. Hence, there are three regimes in this case. These three regimes are

referred to as low, middle, and high if their DIV_{HHI} or DIV_{NIOIR} fall below γ_1, within the ranges γ_1-γ_2, and exceed γ_2, respectively. These show the location of the threshold values and their 95% confidence interval by computing the LR test mentioned above. According to the threshold test results our double threshold regression model from the model can be expressed as model (2.11) and (2.12).

Table 5

Threshold Estimates- RAR_{ROE}, DIV_{HHI}

γ_1		γ_2
0.40432900		0.37980523
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.37980523	> 0.37980523; < 0.40432900	> 0.40432900

Table 6

Threshold Estimates- RAR_{ROE}, DIV_{NIOIR}

γ_1		γ_2
0.25485232		0.28128672
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.25485232	> 0.25485232; < 0.28128672	> 0.28128672

Table 7

Threshold Estimates- Z-score, DIV_{HHI}

γ_1		γ_2
0.37955960		0.40432900
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.37955960	> 0.37955960; < 0.40432900	> 0.40432900

Table 8

Threshold Estimates- Z-score, DIV_{NIOIR}

γ_1		γ_2
0.25460196		0.28128672
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.25460196	> 0.25460196; < 0.28128672	> 0.28128672

CONCLUSION

Within this study, we can learn the trend of diversification of banks and credit unions

throughout the years, both of these two types of financial organizations enhance their degree of diversification. That means they do more non-interest income activities to earn more of their operating income. That is why the two diversification ratios, DIV_{HHI} and DIV_{NIOIR}, are increasing.

The panel threshold regression model can find the relationships of variables under different regimes and efficiently estimate results powerfully, by using the bootstrapping technique. After running the Panel Threshold Regression Model, we can clearly know when banks and credit unions in Taiwan do diversification, then that would definitely influence their financial performance and risk. Here we use RAR_{ROE} to be the performance variable and Z-score, risk variable. Because the single and double threshold tests are both significant, there are three regimes of banks and credit unions' diversification level. Under certain level, that would come out different influence to their financial performance and insolvent risk. So making decisions of doing diversifications becomes a very important idea for management of banks and credit unions.

The findings can help researchers to understand that different types of financial institutions may optimally choose different degrees of diversification, which sheds some light on the inconsistent findings in the literature regarding the relationship between diversification and firm values. And for banks and credit unions, they can evaluate their conditions to meet the exact one in our research, then, decide what degree of diversification they can do to enhance their performance and reduce risks.

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Off-balance Sheet Activities and Bank Efficiencies: The Three-Stage Data Envelopment Analysis with Undesirable Outputs

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Tsui-Chu Chang, National Taipei University of Technology, Taiwan
tsuichu@hotmail.com

ABSTRACT

This study evaluates bank efficiencies in Taiwan using the three-stage DEA proposed by Fried, Lovell, Schmidt and Yaisawarng(2002), and accounts for the impact of the OBS activities on bank efficiencies. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies. The data consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan. The results demonstrated that the main influence of environmental factors on efficiency is macroeconomic variables. Besides, after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

Keywords: Efficiency, Off-balance sheet activities, Three-stage data envelopment analysis, Undesirable output

INTRODUCTION

In recent years, the financial deregulation and innovation have changed the product mix of banks. Banks are active in developing new forms of financial products like the off-balance sheet (OBS) activities. During 2002 to 2007, the nominal value of the OBS activities expanded rapidly in Taiwan, with an increase of nearly 246%. As a result, the non-interest income, of which a large portion is from the fee-based the OBS activities, has increased from 16% in 2002 to 22% of the total income in 2007(Table 1). It indicates that the OBS activities play an important role in the banking operations. Thus, it is important to include these activities in the evaluation of the bank efficiencies.

Previous researches regarding the evaluation of the bank efficiencies seldom take the OBS activities into account. Recent studies using data envelopment analysis (DEA) or stochastic

Table 1

The nominal value of the OBS activities and the ratio of non-interest income to total income

Year	The nominal value of the OBS activities	The ration of non-interest income to total income (%)
2002	2,939,564	16.15%
2003	3,663,615	23.86%
2004	6,259,222	26.43%
2005	6,623,675	22.76%
2006	8,910,494	19.36%
2007	10,183,951	22.41%

Notes: The nominal value of the OBS activities are the aggregate of loan commitments, guarantees, letter of credit issued, and liabilities trusted. The unit of the OBS activities are in NT$ million.

frontier approaches (SFA) begin to include either non-interest income (Roger, 1998; Drake, 2001; Tortosa-Ausina, 2003) or the OBS items (Isik and Hassan, 2003; Casu and Girardone, 2005; Liu, Yeh, and Chiu, 2005) as additional output factors. Additionally, other studies(Clark and Siems, 2002; Isik and Hassan, 2003; Liu, et al., 2005) argue that omitting the OBS activities in the estimation of bank efficiencies may result in under-estimating the actual bank outputs, which may lead to biased conclusions. Therefore, this study is going to take the OBS activities into account when evaluating the efficiency of banks.

The purpose of this study is to evaluate bank efficiencies in Taiwan using the three-stage DEA proposed by Fried, Lovell, Schmidt and Yaisawarng(2002), and to account for the impact of the OBS activities on bank efficiencies. The OBS activities, such as the fee-based services, guarantees, commitments, and derivative securities, can earn the non-interest income for banks on the one hand, but may increase the operational risk on the other hand. Banks want to make more profit but to avoid risks. Therefore, we divide the outputs into the desirable outputs and the undesirable outputs. The revenue contribution of the OBS activities is defined as the desirable output, which is proxied by the non-interest income. While the risk side of the OBS activities is defined as the undesirable output, which is proxied by the nominal value of the OBS activities. Additionally, a lot of researches relating to the efficiency of financial institutions (Chang, 1999; Park and Weber, 2006; Chen, Yu, Chang, and Hsu, 2007) treat non-performing loans as the undesirable output. Non-performing loans are an undesirable by-product of the loan production process, and they are unavoidable. Thus, non-performing loans are also the undesirable output in this study.

The contribution of this study is as follows. First, no previous researches have divided the OBS activities into desirable output and undesirable output. Second, according to the literature of the three-stage DEA, no one use the slack-based DEA with undesirable outputs in the first and third stage of the three-stage DEA. In this study, the three-stage DEA is applied to purge the environmental factors and statistical noise, and this study also divides the OBS activities into the desirable output and undesirable output.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature. Section 3 outlines the methodology of the three-stage DEA, and introduces the model this study used. Section 4 presents data and variables. Section 5 discusses the empirical results, and Section 6 concludes the study.

LITERATURE REVIEW

The impact of the OBS activities on the bank efficiencies

The OBS activities, such as the fee-based services, guarantees, commitments, and derivative securities, are contingent assets and liabilities, which remain only in the notes to financial statements. Although the OBS activities are not make into a list of balance sheet, they will influence the cash flows of banks in the future. Therefore, recent studies think the OBS activities should be took into account when evaluating the efficiency of banks.

Clark and Siems (2002) employ the distribution free and stochastic frontier estimation methods to derive the cost and profit X-efficiency of banks, and investigate the impact of the OBS activities on the measurement of X-efficiency. They also examine the relationship between X-efficiency scores, bank size, and the composition of the OBS activities. The results indicate that the estimation of economic cost and production cost X-efficiency increase with the inclusion of the OBS measure, whereas the estimation of profit X-efficiency is largely unaffected. Further, the OBS activities can help to explain the differences between banks in the evaluation of cost and profit X-efficiency.

Isik and Hassan(2003) utilize DEA to measure Turkish bank' efficiencies fist, and then employ the Malmquist total factor productivity change index to examine productivity growth, efficiency change, and technical progress in Turkish commercial banks during the deregulation of financial markets in Turkey. They also investigate the influence of omitting the OBS activities on the efficiency of banks. The results show that the financial deregulation indeed improves the performance of Turkish banks, and productivity growth is mainly driven by efficiency increases rather than technical progress. The results also point out that

exclusion of the OBS activities may lead to biased conclusions, especially against the banks that are active in these non-traditional activities.

Liu, et al. (2005) adopt the stochastic cost frontier method to explore the impact of the OBS activities on the efficiency of Taiwan's banks during 1998 to 2001, and compare the cost inefficiency with or without the OBS activities. The results suggest that omitting the OBS activities result in under-estimating the cost efficiency. In addition, large banks have higher cost efficiencies, and have an ability to develop the OBS activities.

Casu and Girardone (2005) employ Malquist total factor productivity index to inspect the influence of the OBS activities in the definition of output on European banks' productivity. The results demonstrate that inclusion of the OBS activities increases the estimated productivity, and exclusion of the OBS activities may lead to under-estimate the productivity.

Pasiouras (2007) adopts DEA to estimate the efficiency of Greek commercial banks in the period of 2000 to 2004, and considers the effect of credit risk and the OBS activities. The loan loss provisions are as an extra input item to represent the credit risk of banks, and the OBS activities are as an additional output to explain the fact that banks are active in these non-traditional activities recently. This research also investigates the determinants of efficiency utilizing Tobit regression analysis. The results indicate that the loan loss provisions as an input increases the efficiency scores, but the OBS activities as an output do not have a significant impact. Additionally, capitalization, loan activity, market power and the number of branches have a positive and significant impact on efficiency.

To summarize, most of the studies investigates the impact of the OBS activities on banks' efficiency by adopting DEA or SFA. However, no previous researches have divided the OBS activities into the desirable output and the undesirable output. Therefore, this study divides the OBS activities into the desirable output and the undesirable output. The revenue contribution of the OBS activities is defined as the desirable output, which is proxied by the non-interest income. While the risk side of the OBS activities is defined as the undesirable output, which is proxied by the nominal value of the OBS activities.

The efficiency of financial institutions with the undesirable output

In the estimation of producers' performances, the earliest study which take undesirable outputs into account is Pittman (1983), and then Färe, Grosskopf, Lovell and Pasurka (1989) develop a non-linear DEA program to handle the situation that the desirable outputs are increased and the undesirable outputs are decreased.

Chang (1999) utilizes a non-parametric approach to incorporate risk into the measurement of technical efficiencies of the major financial intermediaries in rural Taiwan, and analyzes the relationship between risk and efficiency. Risk indicators are treated as undesirable outputs, including non-performing loans, allowance for loan losses, and risky assets. The results suggest that incorporating risk as an undesirable output has significant impact on the efficiency of credit departments of farmers' associations.

Park and Webber (2006) use directional technology distance function of 1992 to 2002, and the non-performing loans are treated as undesirable output. The results show that Korean banking industry experiences productivity growth which is mainly due to the fact that technical progress is more than enough to offset efficiency declines.

To summarize, in the study of evaluating the efficiency of financial institutions with the undesirable output, most studies treat non-performing loans as the undesirable output. Non-performing loans are an undesirable by-product of the loan production process, and they are unavoidable. However, no studies examine the effect of the OBS activities on the efficiency of financial institutions. Thus, non-performing loans and the risk side of the OBS activities are treated as the undesirable outputs in this study.

Three-stage DEA is used in estimation of financial institutions' efficiencies

Three-stage DEA is proposed by Fried, et al. (2002). They think the performance of producers is influenced by the environmental factors, managerial inefficiency, and statistical noise. Thus, in order to get the correct efficiency scores and ranking, the managerial inefficiency should be isolated from environmental factors and statistical noise.

Pastor (2002) adopts three-stage DEA to obtain the measurements of efficiency adjusted for risk and environment, and decomposes the bad loan into its two components: one part is caused by the bad risk management and another is caused by exogenous economic and environmental factors. The results suggest that about 80% of bad loan is due to internal factors of firms, while the rest is due to exogenous conditions of firms.

Drake, Hall, and Simper (2006) evaluate the technical efficiency of Hong Kong financial institutions during the period of 1995 to 2001 by using three-stage DEA. The results indicate that the Hong Kong banking industry is indeed affected by external factors, like macroeconomic and housing market factors.

Chen, Yu, Chang, and Hsu (2007) extend three-stage DEA proposed by Fried, et al. (2002) to

improve the measurement of productivity growth. The directional distance function with undesirable output is used in the first stage, and non-performing loans are treated as the undesirable output. In the second stage, SFA is adopted to regress the estimated output slacks against the environmental variables. After eliminating the influence of environmental factors and statistical noise, the Malmquist-Luenberger productivity index is applied to measure the productivity growth.

Chiu and Chen (2008) employ the three-stage DEA to estimate the efficiency of 29 banks in Taiwan during the period of 2002 to 2004. In the first stage, super slacks-based measure (SBM) is used to obtain the initial efficiency scores. SFA is then adopted to estimate the external environment risk effects in the second stage. Finally, in the third stage, they reuse the SBM model again to evaluate the efficiency which eliminates the effect of environmental factors. The results show that external environmental variables do influence the efficiency of domestic banks.

To sum up, in the previous studies of measuring the efficiency of the financial institutions by using the three-stage DEA, only Chen, et al. (2007) account for the undesirable output in their three-stage DEA model. Nevertheless, the model they used is the directional function with the undesirable output, while the model we used in the first and third stage is slack-based measure (SBM) with undesirable outputs proposed by Cooper, Seiford, and Tone (2007).

METHODOLOGY

The three stage DEA is employed to measure the efficiency of banks in Taiwan. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. The goal is to purge the influence of environmental variables and statistical noise on the input and output slacks. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies.

In the first stage of the three-stage DEA

The model we used is proposed by Cooper, et al. (2007). They modify the slack-based measure (SBM) model proposed by Tone (2001) so as to account for the undesirable outputs.

$$\rho^* = \min \frac{1 - \frac{1}{m}\sum_{i=1}^{m} \frac{s_{io}^-}{x_{io}}}{1 + \frac{1}{s}\left[\sum_{r=1}^{s_1} \frac{s_r^g}{y_{ro}^g} + \sum_{r=1}^{s_2} \frac{s_r^b}{y_{ro}^b}\right]}$$

subject to

$$\begin{aligned} x_o &= X\lambda + s^- \\ y_o^g &= Y^g\lambda - s^g \\ y_o^b &= Y^b\lambda + s^b \\ L &\le e\lambda \le U \\ s^-, s^g, s^b, \lambda &\ge 0 \end{aligned} \tag{1}$$

Where λ is the intensity vector, and L and U are the lower and upper bounds of the intensity vector, respectively. The output matrix Y is decomposed into (Y^g, Y^b) where Y^g and Y^b denote good (desirable) and bad (undesirable) output matrices, respectively. The vector s^- and s^b correspond to excess in inputs and bad outputs, respectively, while s^g expresses shortage in good outputs.

In the second stage of the three-stage DEA

The dependent variable is the input and output slack obtained from the first stage, and the objective of this stage is to eliminate the influence of environmental variables and statistical noise on the input and output slacks.

$$\begin{aligned} S_{ij} &= f^i(Z_j;\beta^i) + v_{ij} + u_{ij} \\ S_{rj} &= f^r(Z_j;\beta^r) + v_{rj} + u_{rj} \\ i &= 1,2,...,m;\ r = 1,2,...,s;\ j = 1,2,...,n \end{aligned} \tag{2}$$

Where S_{ij} and S_{rj} are the *j*-th firm of *i*-th input and output slack, respectively. Z_j is the *k*-th environmental factors of the *j*-th firm, and β^i and β^r represent the estimated parameters. The v_{ij} and v_{rj} are error term which assume $v_{ij}, v_{rj} \sim N(0, \sigma_v^2)$, and independent of the u_{ij} and u_{rj} where they are nonnegative random variables accounting for managerial inefficiency which assume $u_{ij,}\, u_{rj} \sim N^+(u\ , \sigma_u^2)$.

$$X_{ij}^A = X_{ij} + [\max_j\{z_j\hat{\beta}^i\} - z_j\hat{\beta}^i] + [\max_j\{\hat{v}_{ij}\} - \hat{v}_{ij}] \tag{3}$$

$$Y_{rj}^{g,A} = Y_{rj}^g + [z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}] + [\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}] \tag{4}$$

$$Y_{rj}^{b,A} = Y_{rj}^{b} - [z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}] - [\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}] \quad (5)$$

After regressing against a set of environmental variables, the initial input and output have to be adjusted. The equation (3), (4), and (5) are used to adjust for the environmental effects and statistical noise. Where X_{ij}, Y_{rj}^{g}, and Y_{rj}^{b} are the initial input, desirable output and undesirable output, respectively. X_{ij}^{A}, $Y_{rj}^{g,A}$, and $Y_{rj}^{b,A}$ denote the adjusted input, desirable output, and undesirable output, respectively. The equation of $[\max_j\{z_j\hat{\beta}^i\} - z_j\hat{\beta}^i]$ and $[z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}]$ are in order to let producers in the same operating environment, and the equation of $[\max_j\{\hat{v}_{ij}\} - \hat{v}_{ij}]$ and $[\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}]$ are in order to let producers in the condition where is not affected by statistical noise.

In the third stage of the three-stage DEA

Stage 3 is a repetition of stage 1, with observed input (X_{ij}), desirable output (Y_{rj}^{g}), and undesirable output (Y_{rj}^{b}) replaced with adjusted input (X_{ij}^{A}), desirable output ($Y_{rj}^{g,A}$), and undesirable output ($Y_{rj}^{b,A}$), respectively. The input and output of this stage is eliminated from the effect of environmental factors and statistical noise, so the efficiency scores this stage obtained is got rid of the influence of the environmental factors and statistical noise.

EMPIRICAL RESULTS

DATA AND VARIABLES

The data used in this study consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan. There are three inputs and five outputs. The input factors are interest expense and non-interest expense. The output factors include three desirable outputs (i.e., non-interest income, deposits and total loans) and two undesirable outputs (i.e., the nominal value of the OBS activities and the non-performing loans). Moreover, five environmental variables are employed in the second stage of the three-stage DEA, including the number of years that the bank has been operating, branches in city, economic growth rate, growth rate of money supply and unemployment rate. Drake, et al.(2006) point out that the primary external influence on efficiency in the Hong Kong banking industry is the macroeconomic cycle. Thus, we choose three macroeconomic variables in this study. Table 2 shows the description of variables.

In the first stage, initial input and output should be used to calculate the initial efficiency scores. Table 3 shows the summary statistics of efficiency scores in the fist stage for the period from 2005 to 2007. The efficiency scores obtained from the first stage is not adjusted

Table 2

The description of variables

Symbol	Variable	Definition	Unit
Inputs			
X1	Non-interest expense(NIE)	Operating cost–interest expense	NT$ hundred millions
X2	Interest expense(IE)		NT$ hundred millions
Desirable outputs			
Y1	Non-interest income(NII)	Operating revenue–interest income	NT$ hundred millions
Y2	Deposits(DE)	Checking deposit, demand deposit, time deposit, and negotiable certificates of deposit	NT$ hundred millions
Y3	Total loans(TL)	Short-term loans and long-term loans	NT$ hundred millions
Undesirable outputs			
B1	The nominal value of the OBS activities(OBS)	loan commitments, guarantees, letter of credit issued, and liabilities trusted	NT$ hundred millions
B2	Non-performing loans(NPL)		NT$ hundred millions
Environmental variables			
Z1	the number of years that the bank has been operating (YEAR)	The number of years that the bank was established to the end of 2007	
Z2	branches in city (CITYBR)	The number of branches in Taipei and Kaohsiung in Taiwan.	
Z3	economic growth rate (EGR)		%
Z4	growth rate of money supply(M2)		%
Z5	unemployment rate (UR)		%

by the environmental factors and statistical noise. The average of efficiency scores in 2005, 2006, and 2007 are 0.747, 0.61, and 0.572, respectively. The standard deviations of efficiency scores in 2005, 2006, and 2007 are 0.285, 0.352, and 0.371, respectively.

In the second stage, input and output slacks should regress against a set of environmental variables. Table 4 shows the stochastic frontier estimation results in the second stage. The number of years that the bank has been operating has a negative and significant impact on the non-interest expense slacks and the total loan slacks. The branches in city is significantly and

Table 3
Summary statistics of efficiency scores in the first stage, 2005-2007

Year	2005	2006	2007
No. of DMUs	36	36	36
Average	0.747454581	0.6101759	0.5716803
SD	0.28479596	0.3519829	0.3710175
Maximum	1	1	1
Minimum	0.174433472	0.0687324	0.0424925

positively related to the non-interest expense slack, the interest expense slack, the non-interest income slack, and the total loan slack. The economic growth rate has a significant and positive impact on the non-interest expense slack, non-interest income slack, total loan slack, and non-performing loan slack, but has a significant and negative impact on the interest expense slack, the deposits slack, and the nominal value of OBS activities slack. The money supply rate has significant and positive relation to the most slacks, but has significant and negative relation to the deposits slack and the nominal value of OBS activities slack. The unemployment rate is significantly and negatively related to the most slacks, but significantly and positively related to the nominal value of OBS activities slack and deposits

Table 4
Second stage–stochastic frontier estimation results

Independent variable	Dependent variables						
	NIE slack	IE slack	NII slack	DE slack	TL slack	OBS slack	NPL slack
Constant	–147.04**	5.25**	–374.32**	120.98**	–979.09**	–356.61**	–200.06**
	(2.60)	(1.32)	(5.17)	(2.07)	(5.03)	(33.26)	(1.09)
YEAR	–0.59*	–0.12	–0.08	–0.65	–2.80*	–2.57	0.27
	(0.42)	(0.12)	(0.8)	(1.4)	(2.11)	(6.05)	(0.49)
CITYBR	0.46*	0.22**	1.64**	–0.30	3.67**	6.34	–0.17
	(0.36)	(0.1)	(0.65)	(1.14)	(1.82)	(5.6)	(0.46)
EGR	87.29**	–9.22 *	162.7**	–66.13**	638.57**	–534.29**	86.62**
	(20.29)	(7.14)	(42.42)	(11.34)	(53.07)	(274.57)	(4.32)

Independent variable	Dependent variables						
	NIE slack	IE slack	NII slack	DE slack	TL slack	OBS slack	NPL slack
M2	22.60**	–1.07	44.06**	–47.67**	191.26**	–125.12*	25.34**
	(5.99)	(2.48)	(12.86)	(8.4)	(13.43)	(86.46)	(3.08)
UR	–94.45**	9.98	–165.38**	84.31**	–741.99**	799.54**	–89.59**
	(30.13)	(10.82)	(63.28)	(11.38)	(66.9)	(412.07)	(4.01)

Notes: *Significant at the 10% level. **Significant at the 5% level. The standard deviations are in parenthesis.

Table 5
Comparison of stage 1 and stage 2

	The first stage	The Third stage
Mean	0.6431	0.7775
Std. Deviation	0.3479	0.2212
Minimum	0.0425	0.3586
Maximum	1	1
Wilcoxon Signed Ranks Test	-3.446(0.001)**	

Notes: **Significant at the 5% level. P-value is in parenthesis.

slack. The results also indicate that the main influence of environmental factors on efficiency is macroeconomic variable, and this is consistent with Drake, et al. (2006).

After regressing the input and output slacks against the environmental variables, the input and output are adjusted for the influence of environmental variables and statistical noise. The efficiency obtain from the third stage is eliminated from environmental variables and statistical noise. Table 5 shows the comparison of stage 1 and stage 3. After adjusting for the influence of environmental factors and statistical noise, the mean efficiency scores increase. This study utilizes Wilcoxon signed ranks test to investigate the differences between the stage 1 and the stage 3, and the results is also presented in Table 5. According to the Table 5, it is found that there is a significant difference between efficiency scores of the first stage and the third stage under the significant level of 0.05. It means that after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

CONCLUSION

In this article, we use three-stage DEA propose by Fried, et al. (2002) to measure the efficiency of banks in Taiwan, and account for the impact of the OBS activities on bank efficiencies. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies. The data consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan.

The results demonstrated that the main influence of environmental factors on efficiency is macroeconomic variable. Besides, after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

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A STUDYING OF MEASURING THE E-SERVICE QUALITY OF ONLINE HUMAN RESOURCE AGENCY

Qinan K. Y. Lin, Dr. Bruce C. T. Ho
Institute of electronic commerce, National Chung-Hsing University, Taiwan
Qinan624@gmail.com

ABSTRACT

Research Background –
The Internet has significantly expanded the definition of e-commerce. Recently, the development of online Human Resource (HR) agencies attracts extensive attention in Taiwan. Through still in the infancy, the usage of job searching shows great potential for improving the overall effectiveness of online HR agencies.

Research Purpose –
The age of e-commerce opens numerous possibilities that will extend the understanding of electronic service quality. Beginning in the 2000s, researchers studying service quality began to shift the primary focus of research from the physical dimensions of customer service to the virtual dimensions of electronic service. This paper aims to develop a scale that could be used to measure the service quality of online HR agency and to understand the underlying service quality dimensions.

Design/Methodology/Approach –
The main data collection instrument used in this study was questionnaire. A survey based on website was conducted to test our model. The data was collected from users of online HR websites in Taiwan. The questionnaire extended items to assess the service quality of online HR agency by referring to the e-service quality scale and modified its items. The questionnaire comprises two sections. The first section gathers information from the users' perception of the service quality of online HR agency services. The second section collects information including the respondents' gender, age, education, occupation, time spent online, and frequency of using online HR agency.

Findings/Results –
Within the internet environment, service quality dimensions are different from the physical environment. Therefore, we adapted an e-service quality model in this study as the foundation. Such a theory is only the starting point, requiring explanation in terms of cause and effect. In this paper, we validated that online HR agency can be analyzed by a five-dimension service quality constructs involve efficiency, system availability, privacy, personalization, and responsiveness. These research results underscore the importance of electronic service quality.

Originality/value–
In the last decade of electronic commerce development, we have seen mounting evidence of the usefulness of website designers' incorporating strategies into their website building process. However, theories need to be tied to empirical operations and empirical data. In this paper, the service quality of the online HR agency in Taiwan was measured by an integrated framework. The method was proved more suitable than the previous studies that based on the traditional service quality model. Such an examination may lead to a better understanding of variables that affect CRM performance.

Keywords: e-service quality, online HR agency, B2C website

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THE EFFECTS OF PROJECT'S SOCIAL CAPITAL, LEADERSHIP STYLE, MODULARITY, AND DIVERSIFICATION ON NEW PRODUCT DEVELOPMENT PERFORMANCE

Dr. Li-Yueh Lee, Kun Shan University, Taiwan
wuleliyu@gmail.com
Ms. Shu-Min Li, Cheng Kung University, Taiwan
ra796402@mail.ncku.edu.tw
Mr. Shang-Min Chen, Cheng Kung University, Taiwan
stellaleejh@hotmail.com

ABSTRACT

Due to the rapid advanced information technology and the complicated business environment, firms are facing more and more competitive situations. To overcome this issue, companies try to create new products to stay competitive advantage. This study aims to explore the effects of projects' social capital, leadership style, modularity and diversification on new product development (NPD) performance. Therefore, the research objectives of this study are (1) to develop a comprehensive research framework to integrate the social capital, project leadership style, modularity, team member diversification, and NPD performance; (2) to identify the interrelationships between social capital, project leadership style, modularity level, and team member diversification on NPD performance; (3) to investigate the different level of social capital and project leadership style on NPD performance; and (4) to investigate the different level of modularity and team member diversification on NPD performance.

Using the 500 senior leaders of NPD teams from different manufacturing firms in Taiwan, this study concludes the following five conclusions, (1) higher level participating style of leadership and higher level of social capital generate better NPD performance, (2) higher level of selling leadership style and social capital create better NPD performance, (3) higher level of telling leadership style and social capital facilitate better performance in design change frequency and innovation, (4) higher level of delegating leadership style and social capital enhance better performance in product prototype development and launch proficiency, technological core competency, and innovation level, and (5) higher level of modular of new product leads to better NPD performance. Managerial implications are also illustrated.

Keywords: NPD performance, modularity, leadership style, social capital, project team diversity

RESEARCH BACKGROUND AND MOTIVATIONS

In the dynamic business environment, firm should efficiently innovate new product or new process to fit market demand. In many cases, new product is a direct result of firm innovation. Higgins (1995) contends that innovation will create extreme values towards the organizations and can be regarded as a secret weapon for firms to acquire competitive advantage. Although new product development (NPD) seems to be the only choice for firms to become competitive, it is a risky work. Cooper and Kleinschmidt (1987) estimate that failure rate of the new product is about 75%. Gallo (1992) further argues that, in the grocery industry, the

failure rate for new product is estimated to be 80 to 95 percent. Thus, the NPD process is difficult because there is less synergy between the needs of the project and the firm's existing skills and resource base. In addition, there is a high degree of uncertainty concerning customers' needs and competitor's actions.

In the process of creating new product, several key issues are essential. These include project leader's leadership styles and skills, organizational culture, team member readiness and experience in NPD, team's relationship with other units, etc. In addition, NPD team members with different backgrounds could agitate different idea and may consequently increase the probability of success. Furthermore, according Yli-Renko et al. (2001), social capital can accelerate the probability of NPD success through increasing the freedom of knowledge-sharing. It can agitate different ideas through members' interaction. Finally, as the needs for firms to be able to deliver high quality products at low cost has long been recognized, many companies have adopted modular architecture instead of integrated architecture to achieve rapidly response. The needs of consumer have also become more diversity. New product adopts modular architecture which component could partial upgrade, maintain, repair, and disposal to exchange different function and form for diversity needs (Nevins and Whitney,1989).

Although there are plenty of studies argues for the importance of project leadership, social capital, modularity, and team member diversities for NPD performance. However, none of these studies have tried to integrate these variables together and identified the interaction effects of these variables on NPD performance. Based upon the above research background and motivations, the research objectives of this study are to firstly develop a comprehensive research framework to integrate the influences of social capital, project leadership style, modularity levels, and team member diversity on NPD performance. This study also aims to test the research framework through empirical data.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The Influences of Social Capital and Project Leadership Styles on NPD Performance

According to Bardach (2001), "Leadership is a means for diagnosing and implementing improvements in the operating subsystem of the Inter-organizational collaborative capacity, inducing resource contribution, nurturing an ethos of interpersonal trust and organizational pragmatism". Farris (1988) suggests that true leadership involves much more than effectively managing a group performing a task.

In the NPD team, leader is a key role in the team. He/she uses the knowledge, leadership, empathy, and ability to persuade followers to devote all themselves for achieving goals. Optimal leadership in a NPD team should not only encourage team members to work under diversity of member expertise, limited resources and time pressure but also have competences to handle both technical issues and behavior issues. Based on the above discussions, this study suggests that leadership style has a significant impact on NPD performance. The following hypothesis is proposed:

H1: Team leader's leadership style has significant effect on NPD performance.

Social capital is a set of social resources embedded in relationship (e.g., Burt, 1992; Loury, 1997). Some scholars have brought up social capital to facilitate inter-unit resource exchange, product innovation (Gabbay and Zuckerman, 1998; Hansen, 1999; Tsai and Ghoshal, 1998; Nahapiet and Ghoshal, 1998) and cross-functional team effectiveness (Rosenthal, 1996). This

study tries to view social capital from the perspectives of relational and informational flow. In the process of new product development, the project team requires a great deal of multiple information sources. Social interactions among team members who are strongly tied to each other are likely to develop a shared understanding of the utility of certain behavior. In a highly social capital environment, team members could share different knowledge, emotion, value, and information by formal or informal interaction. According to Laumann, Galaskiewicz, and Marsden (1978), network position is like a set of nodes (e.g., persons, organizations) linked by a set of social relationships (e.g., friendship, overlapping membership) of a specified type. If NPD project team stands on a core network position, this project team is able to interact with outsiders to get more information. In the process of new product development, the NPD team should integrate many factors such as different objects, knowledge, information, team member skills, etc. to create a successful new product. Based on the above discussion, the following hypothesis is developed:

H2: Social capital of the NPD team has significant effect on NPD performance

According to the contingency approach of leadership, an effective leadership style should be contingent upon several environmental factors. ……..???

H3: There is an interaction effect of project leadership style and social capital on NPD performance. NPD team having a higher transformational leadership approach and a higher level of social capital tends to achieve significantly higher NPD performance.

The Influences of Modularity Level and Team Member Diversity on NPD Performance

Modularity refers to "the degree to which a system's components can be separated and recombined" (Schilling, 2000). New products with higher levels of modularity mean that the component could independently operate without affecting others. Product modularity is the practice of using standardized product modules so they can be easily reassembled/ rearranged into different functional forms, or shared across different product lines. Since NPD project team needs to integrate many detailed processes to efficiently create value, it could be very complicate if the products need to be modified to fit the changes of customer needs. The change of one component or feature may require extensive redesign of the product. Therefore, the application of module concept can be very helpful to save a lot of cross functional communication, coordination and simplify the NPD process. Besides, product prototype uses modular design that taking individual blocks inlay in the new product will largely increase product variety for diversity consumer and can achieve economies of scale to reduce the cost of production. Based on these reasons, the following hypothesis is proposed:

H4: The levels of modularity that apply to the new product has significant effect on NPD performance

As mentioned earlier, information and knowledge are very important to promote new product development. In any NPD project, it needs multiple source of information to create value of the new product. NPD project member diversification will intensify different ideas, cognitions, and views to develop new product. Appropriate diversification is helpful for NPD team. In light of these reasons, the following hypothesis is proposed:

H5: Team member diversification has significant effect on NPD performance

As previous section, this study believes that team member diversification will accelerate modularity in NPD project because of multiple source of information or knowledge. This study believes that the interaction of team member diversification and the application of modularity will accelerate NPD performance. So, the following hypothesis is proposed:

H6: There is a significant interaction effect of NPD team member diversification and modularity on NPD performance.

RESEARCH DESIGN AND METHODOLOGY

Research Framework

Based on the above literature and hypothesis development, a research framework including five major constructs and their corresponding interrelationships is developed as shown in Figure 1. This research framework is used for further empirical validations in the later sections.

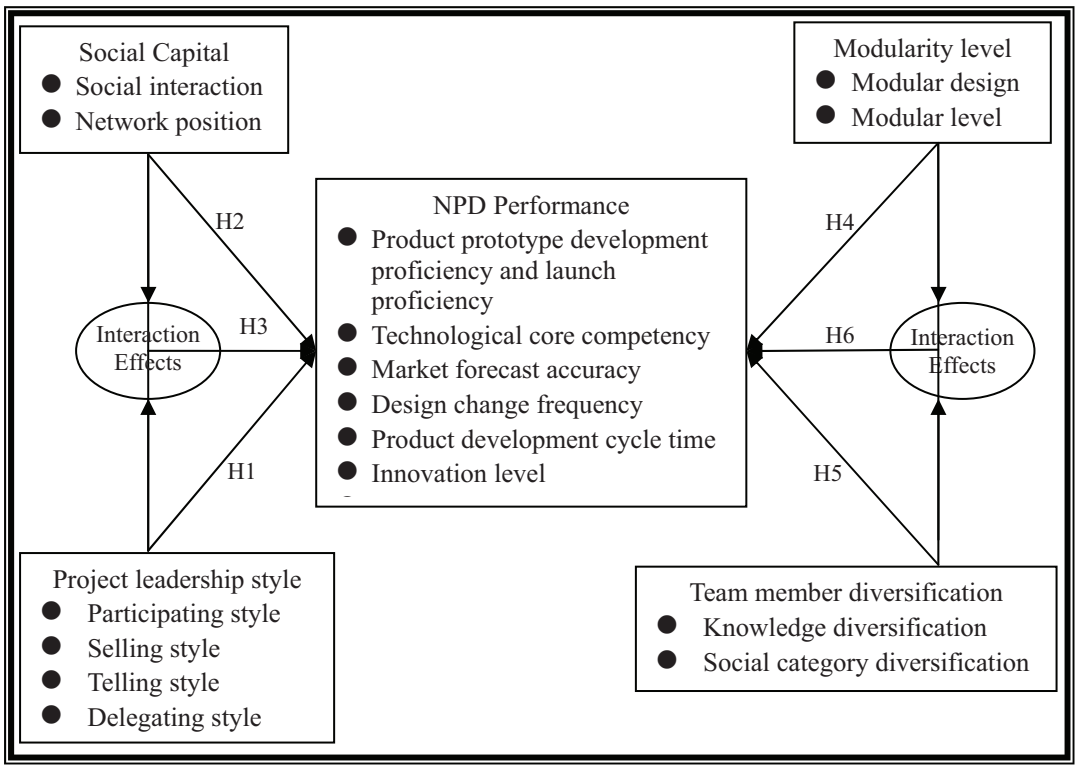

Figure 1 The Research Model

Questionnaire Design and Sampling Plan

There are five constructs to be measured in this study: (1) project leadership style; (2) social capital; (3) NPD performance; (4) modularity level; and (5) team member diversification. A preliminary version of this questionnaire is adopted from previous studies with some modifications based on the specific requirements of this study. Inter-judge reliability is conducted through the judges of one professor and two Ph.D. students major in marketing. Questionnaire items with low inter-judge reliability (i.e., item with two of the three judges disagree with the content) were deleted from the questionnaire items.

A sampling plan is developed to ensure that certain types of respondents are included in this study. This study selects 500 senior leaders of NPD teams from different manufacturing companies in Taiwan. The sampling frame is obtained from "The manager directory in Taiwan (2006)" published by *China Credit Information Service Inc.* As this study chooses senior NPD leaders who have participated in a successful NPD project, they are highly likely

to be the most knowledgeable about the topics in the questionnaire. The respondents are asked to express their perceptions on NPD performance, social capital, team member diversification, modularity level, and project leadership styles based on a specific NPD project that they participated. SPSS 13.0 is employed to analyze the data and to test the hypotheses.

RESULTS AND DISCUSSION

Descriptive Analysis

Descriptive analyses are conducted to provide information about the characteristics of respondents. Table 1 shows the basic attributes of the sample firms. These attributes includes five major items in the study: (1) industry, (2) history, (3) capital, (4) annual sales, and (5) number of employees.

Table 1 Characteristics of Sample Firms (n=95)

Industry					**History (year)**				
Information and Electrical Industry		Mechanical Industry	Chemical and Pharmaceutical Industry	Others	< 10	11 to 20	21 to 30	31 to 40	> 40
28		21	8	38	15	27	18	16	19
29.5%		22.1%	8.4%	40.0%	15.8%	28.4%	18.9%	16.8%	20.0%
Capital (million NTD)					**Annual Sales (million NTD)**				
< 80	81 to 200	201 to 500	501 to 1000	> 1000	< 100	101 to 500	501 to 1000	1000 to 10000	> 10000
14	10	18	16	37	10	17	14	34	20
14.7%	10.5%	18.9%	16.8%	38.9%	10.5%	17.9%	14.7%	35.8%	21.1%
Number of Employees									
< 500		501 to 1500	1501 to 3000		3001 to 5000		5001 to 10000	> 10000	
47		24	12		5		3	4	
49.5%		25.3%	12.6%		5.3%		3.2%	4.2%	

Reliability of the Research Construct
Interrelationships between Research Variables

Effect of Project Leadership Style on NPD Performance

According to Sherman, Berkowitz, and Souder (2005), NPD performance can be measured by product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time, and innovation level. Hersey, Blanchard, and Johnson (1996) suggest that project leadership style can be divided into participating, selling, telling, and delegating style. In order to test hypothesis 1, regressions with ordinary least squares (OLS) estimation method are employed on the full sample data. Table 2 presents the results of the regression using six factors of NPD performance as the dependent variables. The regression results suggest that, product prototype development (regression model M1-1) and launch proficiency is significantly influenced by participating style (β=0.388, $p<0.05$) and delegating type (β=0.166, $P<0.05$).

Table 2 Effect of Project Leadership Style on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M1-1	M1-2	M1-3	M1-4	M1-5	M1-6
Participating style (lsf1)	0.388***	0.3**	0.153	-0.165	.309**	0.166
Selling type (lsf2)	0.131	0.225*	0.180	0.069	0.054	0.071
Telling type (lsf3)	0.094	-0.089	-0.055	***-.404	0.075	.207**
Delegating type (lsf4)	0.166*	0.019	-0.019	0.066	0.030	0.075
R^2	0.289	0.251	0.099	0.165	0.126	0.098
Adj-R^2	0.258	0.217	0.059	0.128	0.087	0.058
F	9.163	7.527	2.462	4.443	3.230	2.452
D-W	2.111	2.117	1.485	1.874	1.781	2.015

In addition, technological core competency (regression model M1-2) is significantly influenced by participating style (β=0.300, P<0.01), and selling style (β=0.225, P<0.001,). The significantly positive coefficients indicate that the levels of participating style and selling style all contribute to the level of technological core competency. Furthermore, none of the independent variables has a significant influence on market forecast accuracy (regression model M1-3) as shown in Table 1. The design change frequency (regression model M1-4) is significantly influenced by telling style (β=-0.404, P<0.01). This result may suggest that a telling leadership approach will result in less design change frequency from product prototype development to volume production. The product development cycle time (regression model 1-5) is significantly influenced by participating style (β=0.309, P<0.01). The significantly positive coefficients indicate that the levels of participating leadership contributes to the level of product prototype development cycle time. Finally, innovation level (regression model M1-6) is significantly influenced by telling style M1-6 (β=0.207, P<0.05) The significantly positive coefficients indicate that the levels of telling style contribute to the innovation level. Based on these, hypothesis H1 is partial supported.

The Effects of Modularity Level on NPD Performance

Table 3 presents the effects of the modularity level on NPD performance, it is suggested that NPD performance is significantly influenced by modular design and modular level. The significantly positive regression coefficients indicate that degree of modular design and modular level can contribute to the factors of NPD performance. The results indicate that both modular design and modular level have significant influences on product prototype development and launch proficiency (β=0.226-0.229, p<0.05), and product development cycle time (β=o.211-0.260, p<0.05). Modular level is positively related to market forecast accuracy (β=0.186, p<0.05) and innovation level (β=0.239, p<0.05), but negatively related to design change frequency (β=-0.315, p<0.05). Therefore, hypothesis 4 is supported.

Table 3 The Effects of Modularity Level on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M2-1	M2-2	M2-3	M2-4	M2-5	M2-6
Modular design(mlf1)	.229**	.357***	0.176	0.050	.26**	-0.095
Modular level (mlf2)	.226**	-0.051	.186*	***-.315	.211**	.239**
R^2	0.145	0.116	0.092	0.090	0.155	0.048
Adj-R^2	0.126	0.096	0.072	0.070	0.137	0.028
F	7.774	6.015	4.649	4.522	8.442	2.339
D-W	2.048	1.886	1.600	1.657	1.930	1.905

Effect of Social Capital on NPD Performance

Table 4 presents the results of regressions of NPD performance, while using all six factors of NPD performance as the dependent variables. The results indicate that social interaction (scf1) is positively related to product prototype development and launch proficiency, technological core competency (β=0.387, $p<0.05$) and market forecast accuracy (β=0.368, $p<0.05$), while network position (scf2) is positively related to product prototype development and launch proficiency (β=0.312, $p<0.05$), product development cycle time (β=0.228, $p<0.05$) and innovation level (β=0.37, $p<0.05$), but negatively related to design change frequency (β=-0.368, $p<0.05$).

Table 4 Effect of Social Capital on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M3-1	M3-2	M3-3	M3-4	M3-5	M3-6
Social interaction (scf1)	.391***	.387***	0.368***	0.056	0.078	.182
Network position (scf2)	.312***	0.118	0.016	***-.368	.228**	.37***
R^2	0.366	0.207	0.141	0.119	0.075	0.234
Adj-R^2	0.352	0.190	0.123	0.100	0.055	0.217
F	26.509	12.018	7.511	6.205	3.734	14.052
D-W	2.238	1.928	0.151	1.749	1.673	2.175

Effect of Team Member Diversification on NPD Performance

Table 5 presents the influences of NPD team diversification on NPD performance. The results indicate that for all six regression models, both knowledge diversification and social category diversification do not have significant impacts on the factors of NPD performance, including product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time and

innovation level. Since previous studies have shown a significant relationship between teams member diversifications and NPD performance, this issue may be subject to further validations.

Table 5 Effect of Team Member Diversification on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M4-1	M4-2	M4-3	M4-4	M4-5	M4-6
Knowledge diversification	0.100	-0.049	0.089	0.024	-0.020	0.007
Social category diversification	0.014	-0.053	0.050	0.067	0.152	-0.076
R^2	0.011	0.007	0.013	0.006	0.022	0.005
Adj-R^2	0.000	0.000	0.000	0.000	0.000	0.000
F	0.515	0.314	0.622	0.285	1.015	0.254
D-W	2.044	1.826	1.514	1.548	1.514	1.935

CONCLUSION AND SUGGESTION

The major objective of this study is to identify the interrelationships among social capital, leadership style, modularity, and team member diversification on NPD performance. Based on the results of this study several conclusions and implications based on these conclusions are drawn.

The first conclusion is that higher level participating style of leadership and higher level of social capital will bring better NPD performance. That means NPD leaders who adopt participative leadership style will result better performance in product prototype development and launch proficiency, technological core competency, market forecast accuracy, cycle time, and innovation if the NPD members are willing to interact with other members. Participating style has no effect on reducing product design change from product prototype to volume production. It's possible that participating leadership style let members to heavily participate project goals, it inevitable will face divergence in opinions. When members have divergence in opinions, it could result product design continuously change to fit different opinions of the team members. It is suggested that NPD leaders should try to enhance member interactions and share multiple sources of information in NPD project. These results are consistent with Nieto, Shim and Lee (2001) who conclude that project leaders differ not only in the general level of influence but also in how to mix various influence tactics, in the R&D project, leader adopts relational behaviors will get higher output.
The second conclusion is that higher level selling style of leadership and higher level of social capital will lead to better NPD performance. But, selling leadership style seems do not influence significantly the design change frequency and product development cycle time. It is suggested that when followers have no ability and willingness, the leader should adopt selling leadership. At that same time, leader should increase followers formally or informally to interact and share multiple source of information in NPD project to get higher NPD performance. These results are consistent with Sashittal (1998) and Olson et al. (2001).

The third conclusion is that higher level of telling leadership style and higher level of social capital will bring better performance in design change frequency and innovation. But it seems that more telling style will lead to bad performance in product prototype development and launch proficiency, technological core competency. Hersey, Blanchard, and Johnson (1996) suggest that, when the followers are unwilling and not capable to work, the project leader should use telling leadership style to lead project members to get better performance. Base on these results, project leaders adopting higher telling leadership style in NPD project may cause staff's bad feeling, and result in bad performance in product prototype development and proficiency and technological core competency. In the process of innovation, telling leadership style has significant effect on NPD performance, but the explain variance is small. It's possible that there are other factors that have been neglected from the model. In fact, there are many factors that will effect innovation. In the process from prototype design to volume production, the multiple source of information can make employees to make fewer mistakes and decrease the frequency of design change. These results are consistent with Howell and Higgins (1990) who state that leader adopts older of leadership to more closed-end project will lead more performance of new product development.

The fourth conclusion is that higher level delegating leadership style with higher level of social capital will bring better performance in product prototype development and launch proficiency, technological core competency, and innovation. Hersey, Blanchard, and Johnson (1996) suggest that when followers have ability and willingness to work, leaders should adopt delegating leadership style to followers. Leaders should increase social capital when they face the project members who are in the highest level of readiness. In the early stage of new product development, leader delegates authority to followers who have ability and willingness that will satisfy their achievement-oriented performance. These results are consistent with Sydow et al. (1998) who conclude that social capital on network processes and effectiveness will speed up NPD performance from structurationist perspective.

The fifth conclusion is that NPD adopting modular design will lead to higher performance on prototype product development and launch proficiency, technological core competency, market forecast accuracy, and product development cycle time. That means that NPD project leader could try to use modular design to development new product. If project team has some previous successful experience, project team may just change some modular to create really new product. Because of the past experience, project team will have better understanding of market to assure the forecast market and to reduce product cycle time. At the same time, the key to successful product modularization is product architecture, a scheme by which functional elements of a product are allocated to structurally independent physical components (Ulrich, 1995; Sanchez, 2000). In the process of designing product architecture, project team members must know the core function of product that could acquire competency to reach diversity functional modules.

The last conclusion is that modular level of new product will lead to better NPD performance except for technological core competency. Potential benefits of modularity include: economies of scale, increased feasibility of product/component change, increase product variety, reduce order lead-time, decoupling tasks, and the ease of product upgrade, maintenance, repair, and disposal (Nevins and Whitney, 1989; Pahl and Beitz, 1988; Corbett *et al*., 1991). These results are consistent with Nieto and Phal and Beitz (1988), Chen and Liu (2004), Huang (2000) and et al. who conclude that modular architectural approach has been an important perspective in product innovation research. The manufacturing industry is

undergoing a major paradigm shift that is taking it from traditional manufacturing into a world of agile manufacturing. An agile corporation should be able to rationalize its manufacturing facilities and produce a large variety of products at lower cost in time. Designs of modular products and reconfigurable processes are crucial to agile manufacturing. Modular product design is becoming a focus and is frequently stated as a goal of good design practice in current engineering areas.

The study results can not confirm that team member diversification has significant effect on NPD performance. This study divides team diversification to two aspects: knowledge diversification and social category diversification. There are different results if we adopt different aspect. Team member characteristics, team cohesion, and environment will affect performance by member interaction (McGrath, 1964). In the process of team member interaction, characteristics of person and task interacts job and team characteristics, just consider personal characteristics is not enough (Salas, 1992). It should combine with task characteristics and personal characteristic. Team member diversification comes from different background, which generates different faith in team and may result many conflicts which reduce team performance (Wiersema and Bantel, 1992). Good and Nelson (1971) suggest that the same years of service have more chance to produce social interaction and team cohesion than diversiform seniority. In the diversification of background function, industry diversification and expertise diversification will have negative effect in communication of information (Smith, 1994).

Although the results of this study are fruitful and the results may contribute to the existing literature for further validation, several suggestions could be made for academicians and business practitioners.

First the model test is conducted in the manufacturing industry in Taiwan. Although this approach enables us to conduct an in-depth study and controls for a considerable amount of environmental ‘noise’ in an important industry, it might limit our ability to generalize our findings. Although this should be subject to further empirical verification, we do not see any a-priori reasons why the effects observed would be different in other industries.

Second, research may use experimental research to confirm the results of this study. For example, business simulations could be adopted to reflect a real environment, and to manipulate different situations of team members. Third, the response rate of this study is very low. This study collects sample data through mail survey. It takes time and efforts to get the answers from the respondents. However, for the respondents, they don’t have pressure to answer the questionnaires. For the future research, the reasonable response rate should be maintained to support the quality of the data.
Even though most of the framework and the relationships between variables have been proved to be significant, the comprehensive model using LISREL test seems to indicate that there are still plenty of rooms to revise and modify results of this analysis and further validation may be required.

Hersey, Blanchard, and Johnson (1996) brought up situational leadership model that a successful leadership style should consider the ability and willingness of followers. In this study, it suggests that further studies can measure the maturity of follower to fit leadership. Further studies should try to find the best leadership model amount leadership style, social capital, and follower’s maturity or characteristic on NPD performance.

Finally, in this study, team member diversification has no effect on NPD performance. This study sums up diversity value to represent diversification. It uses arithmetic average which assumes that different category has the same weight. Further study may find fair weight to show reasonable formula on behalf of team member diversification.

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FOREIGN INVESTMENTS AND DEVELOPMENT OF LIFE INSURANCE COMPANIES. CASE OF POLAND.

Adam Sliwinski, Warsaw School of Economics, Poland
adamy@poczta.onet.pl

ABSTRACT

The main aim of this paper is to demonstrate the relationship between changes in the ownership structure and the development of life insurance companies in Poland. The simple regression model is used to reveal the relation. The findings of this study, that the solvency ratio, overall indebtedness ratio, premiums retention ratio and profitability ratio on technical activity and sales are positively related with the changes in the share of foreign capital and especially that the claims ratio is negatively related, suggest that foreign investments have greatly influenced the development of the life insurance industry in Poland during the transition period.

Key words: ownership structure, insurance, performance

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BUSINESS PERFORMANCE IMPROVEMENT THROUGH MANAGING INTANGIBLE ASSETS

Chaichan Chareonsuk, Shinawatra University, Thailand and
Chuvej Chansa-ngavej*, Shinawatra University, Thailand
chuvej@shinawatra.ac.th

ABSTRACT

This paper aims to establish empirically the interrelationship of three elements of intangible assets: learning and growth, internal business process and external structure and the business performance. The cause-effect relationships between intangible assets and business performance were investigated in companies of various business sizes, business sectors and age of business establishment. A total of 3,084 questionnaires were distributed to the top management of member companies of the Thai Chamber of Commerce. Responded questionnaires were screened for completeness and reliability. The number of qualified responses were 304 and the data were analyzed using the Structural Equation Modeling technique.

The three elements of intangible assets were found to be independent. The type of business, i.e. non-service and service sectors, has not been found to yield significantly different result. However, the cause-effect relationship results of the business size and the age of business establishment are significantly different. Moreover, the commonly assumed cause-effect relationships were confirmed, i.e. the element of learning and growth has influence on internal business process, the element of internal process has effect on external structure and the element of external structure, in turn, has effect on business performance. It was also found that the element of internal process has direct effect on business performance as well.

These findings will enable top management in each size of business, business sector and age of its company to understand the cause-effect relationships and importance of elements of intangible assets (learning and growth, internal business process and external structure) and business performance. Now that the cause-effect relationships are positively identified, long-term strategies for intangible asset management may be formulated and recommended to management. Budget allocation and management can now be more properly focused and controlled to increase sustainable competitive advantage.

Keywords: Intangible assets, Balanced Scorecard, Business Performance, Structural Equation Modeling, business strategy

INTRODUCTION

The current economic crisis has spread over all business sectors. Some businesses have had to close down and gone bankrupt. Profit and loss are normally used as the main financial performance indicators in the balance sheet and annual financial reports. However, annual financial reports might not reflect and influence the crafting of long-term strategies. Financial profit alone could not guarantee the long term survival of companies under economic crisis and a drastically dynamic business environment.

The investment of tangible assets such as equipment, machineries, building, etc, is also recorded in the balance sheet. Whereas the cost of expenses in brand building, customer database, training, product development, information technology, etc, are usually treated as part of the operation cost and marketing expenses. This simple accounting record mechanism has no linkage with long-term strategies and budget allocation. Intangible assets have been widely studied during the last decade.

Intangible assets are defined as non-financial assets without physical substance that are held for use in the production or supply of goods or services or for rental to others, or for administrative purpose (Epstein and Mirza, 2005). Intangible asset is an accounting term, while intellectual capital is a term used in the management field. They both refer to the same thing. Since an increasing share of market value in this era is not represented by inventory or physical assets.

Investments in intangible assets are usually not documented in a proper and systematic manner because of data non-availability. Consequently, reasonable estimates of the future performance potential of an organization could not be provided to the management. It is intriguing to note that the cause-effect relationships between marketing, production and human resource and financial performance have not so far been made operational. Prior to the knowledge era, business lived in the world of tangibles, which worked well with the traditional accounting practices. However, things are different in today's world of intangibles. Modern management style and strategic crafting have adapted in response to global competition and volatile economic environment. The industrial age management has been replaced by the knowledge age leadership, with corresponding transformational effects on the economy and workplace. The focus on tangible assets in industrial age has made a paradigm shift to intangible assets in the knowledge age. As a consequence, issues concerning intangible assets are now more widely researched and practiced. Intangible assets are of increasing importance for the corporate value creation processes of all kinds of organization.

To be sustainable, companies need to understand and be able to manage intangible factors, including organizational learning and growth, internal process and external structure. The intangible assets are the competitive edge over competitors. Ittner (2008) suggested several previous studies provide at least some evidence that intangible asset measurement is associated with higher performance, however, many are limited by over-reliance on perceptual satisfaction or outcome variables, inadequate controls for contingency factors, simple variables for capturing complex measurement practices, and the lack of data implementation practice. In this paper, the balanced scorecard strategy map (Kaplan and Norton, 2004) is used to provide a framework to illustrate how strategy links intangible assets to value creating processes. The measures in the four perspectives are linked together by cause-effect relationships. The company builds the core competence and training to support the internal process. The internal process creates and delivers the customer value proposition. When the customers are satisfied, the sales and profit are delivered in terms of financial performance.

This paper explores the cause-effect relationship of intangible assets, learning and growth, internal process and external structure to business performance. The model is an attempt to refine and extend the balance scorecard strategy map. A total of 3,084 questionnaires have been distributed to the top management of the Thai Chamber of Commerce. The subjects are in various business size, business sector and age of business establishment. The questionnaire

responses were screened for completeness and reliability. The number of qualified responses was 304, which was the total number of responses used in the analysis. The Structural Equation Modeling technique was the analytical tool applied in this empirical investigation. The model fit testing process is illustrated in Figure 1. The initial step in the analysis of the data focuses on examining the frequency distribution and the meaning and standard deviation for each item or variable considered in this research. The next step in data analysis is to assess the validity of measures. Here the study uses item-total correlation, confirmatory factor analysis and the Cronbach alpha coefficient. The initial data analysis and reliability and correlation analyses are performed using the SPSS statistical package. Furthermore, the structural equation modeling EQS program (Bentler, 1995) is used to perform the confirmatory factor analysis, discriminant validity tests and testing of the structural model.

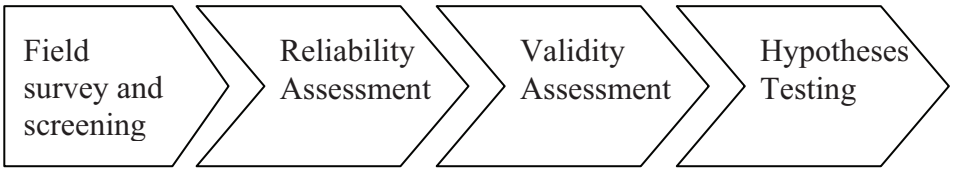

Figure 1. Model fit testing process

LITERATURE REVIEW

During the last two decade years, several studies, Kaplan and Norton (1992), Sveiby (1997), Edvinsson and Malone (1997) and Bontis (2000), have variously attempted to categorized intangible assets. There are common categories of intangible assets as follows:

- Customer/ External structure/Relation capital
- Internal process/ Structural capital
- Learning and growth/human capital/Competence structure

There are several intangible assets indicator in each intangible assets element. By using the categories developed by Hall (1993), Sveiby (1997), Roos et al. (1997) and Shaikh (2004) reviewed and classified the intangible assets into a framework of internal structure, external structure, and employee competence as shown in Table 1.

Table 1. Framework of Intellectual Capital/Intangible assets Indicators

External structure	Brands Customer loyalty Customer satisfaction
Internal structure **or** **Internal Process**	Process Improvement Innovation Information technology
Employee competence **or** **Learning and Growth**	Know-how knowledge Competencies Engagement

The balance scorecard is the most well-known approach that can be used for converting intangible assets into tangible outcomes although its original intent was not meant to be the measure for intangible assets, as discussed by Marr and Adams (2004) and Mouristen et al. (2005). Seggie et al. (2007) made an argument for the balanced scorecard to be the measurement tool in marketing to measure non-financial assets and provide the organization with a long-term perspective. The balance scorecard is at least partially forward-looking and partially geared toward the long-term performance of the firm. The balance scorecard concept has been examined the performance measurement of bonus plan in major financial services firm. Ittner et al. (2003) recommended that the future research on balance scorecard adoption and performance consequences must move to encompass the entire implementation process.

Kaplan and Norton (2004) developed the balance scorecard strategy map to explain the relation of learning and growth, internal process and customer perspective. The concept of cause-effect relationships separates the balanced scorecard from other performance management systems. The measures appearing on the scorecard should be linked together in a series of cause-effect relationships to tell the organization's strategic story. Increasing promotional expenses will lead to the increase in brand value. Increased brand value will lead to higher sales revenue. The investment of human capital will create the continuous learning and growth in the organization. When the employees have more experience and knowledge, they can create the internal process which serves and fulfills customer satisfaction. The profit and revenue are the final outcomes of this causal chain.

Heskett et al. (1994) explained the linkage of the above model that investment in employee training leads to improvement in service quality. Better service quality leads to higher customer satisfaction. Higher customer satisfaction leads to increased customer loyalty. Increased customer loyalty generates increased revenues and margins. There are linkages among learning and growth, internal process, customer, and financial performance. Olve et al. (1999) reported that Halifax applied the balance scorecard in business and found the relation that if we have the right staff, we will get "doing the right thing" and customers will be delighted. When the customers are delighted, we will get more business.

There are many functions involved in aligning the intangible assets with strategies. Each function has to build its own intangible assets in order to deliver and convert them to financial performance. Chareonsuk and Chansa-ngavej (2006) found that most of companies in the Stock-Exchange of Thailand have functional organization structure.

The intangible assets are linked to performance. The balanced scorecard has been widely used in formulating business strategy. Green and Ryan (2005) proposed the framework of intangible valuation areas for facilitating the systematic and repeatable identification of intangible assets balanced scorecard. It is designed to align the value drivers of intangible assets with its business strategy. Understanding the value of its intangible assets helps a business to develop, sustain and enhance its mission effectiveness and competitive advantage. Chareonsuk and Chansa-ngavej (2008) proposed the framework for intangible assets management in business and industrial organization. The framework refines the strategy map concept in the balanced scorecard approach for use in intangible assets management. Intangible assets belong to different functional departments. They must be carefully monitored and properly nurtured by the organization. Intangible assets depend not only on the type of functional departments but also the type of industries.

The data that could be gathered on the issues of intangible assets could be divided into two types as shown in Table 2.

Table 2. Intangible assets relationship analysis methods

Methods	Advantage	Disadvantage
Direct way : Financial quantitative data	Direct analysis from reliable financial data	Difficulty to obtain the financial data in some countries.
Indirect way : Questionnaire	Widely distribute to all industries in any conditions.	The results are highly susceptible to the questions' design and the respondent's attitude. (Chen et al. 2005)

There is some difficulty in obtaining data of intangible assets in financial reports for direct testing of the relationship. Thus, there are several empirical studies using the questionnaires as shown in Table 3.

Table 3. Previous Empirical studies

Studies	Methodology	Empirical Finding/ Result
Bontis et al., 2000	Questionnaire 107 respondents both service and non-service industries. Analyzed by structural equation modeling and Partial Least Squares	Intellectual capital has a significant and substantive relationship with business performance regardless of industry sector.
Carmeli and Tishler, 2005	Questionnaire 99 respondents of general management of local authority in Israel. Use multivariate analysis approach, robust canonical analysis (RCA)	Intangible organization elements (managerial capabilities, human capital, perceived organizational reputation, internal auditing, labor relations and organizational culture) have a significant positive effect on the performance of the organization.
Nagar and Rajan, 2005	Marketing and customer satisfaction survey 87 retail banks. Analyzed by linear regression.	Customer relationship activities link to business performance.
Chin et al., 2005	Gather financial data of 1,386 samples companies listed. Trademark value estimation by Seethamraju (2003).	Trademark/Brand is positively associated with firm's performance.
Wang and Chang, 2005	Gather data from 131 IT firm in Taiwan and analyzed the model by partial least square (PLS) method	Human capital has no direct effect on performance. Innovation, process and customer capital have direct effect on performance. Human capital directly affects innovation and process capital. Innovation and process capital further influence performance.
Chen et al., 2005	Gather data from 4,254 registered companies and analyzed the hypotheses by statistic testing.	Intellectual capital has a positive impact on financial performance.
Cabrita and Vaz, 2006	53 banks (253 samples) in Portuguese banking were tested using PLC testing model	Intellectual capital is significantly related to the organizational performance.
Moon and Kym, 2006	200 questionnaire analyzed and using SEM (AMOS) for model testing	Human capital has a positive effect on relational capital and that both human and relational capital affect structural capital
McKeen et al., 2006	90 respondents in US, and analyzed the hypotheses by PLS method	Knowledge management has direct relation to organizational performance. Organizational performance has direct relation to financial performance. No direct relation between knowledge management and financial performance.
Liu and Tsai, 2007	Questionnaire 560 manager from Hi-Tech companies in Taiwan. Statistic *t*-test and ANOVA are used.	Knowledge management has a positive effect on business performance.
Cheng et al., 2008	Directly obtain financial data of 56 companies and analyzed 23 indicators by Tobit's model	Innovation, customer, human and contract capital have some impact on intangible assets.

RESEARCH DESIGN AND METHODOLOGY

The cause-effect relationship is urged in strategic mapping (Kaplan and Norton, 2004). There are also several researchers, i.e. Huselid and Becker (1997), Hitt et al. (2001), Liu and Tsai (2007), studies the relationship between learning and growth and business performance The hypotheses model is constructed in Figure 2.

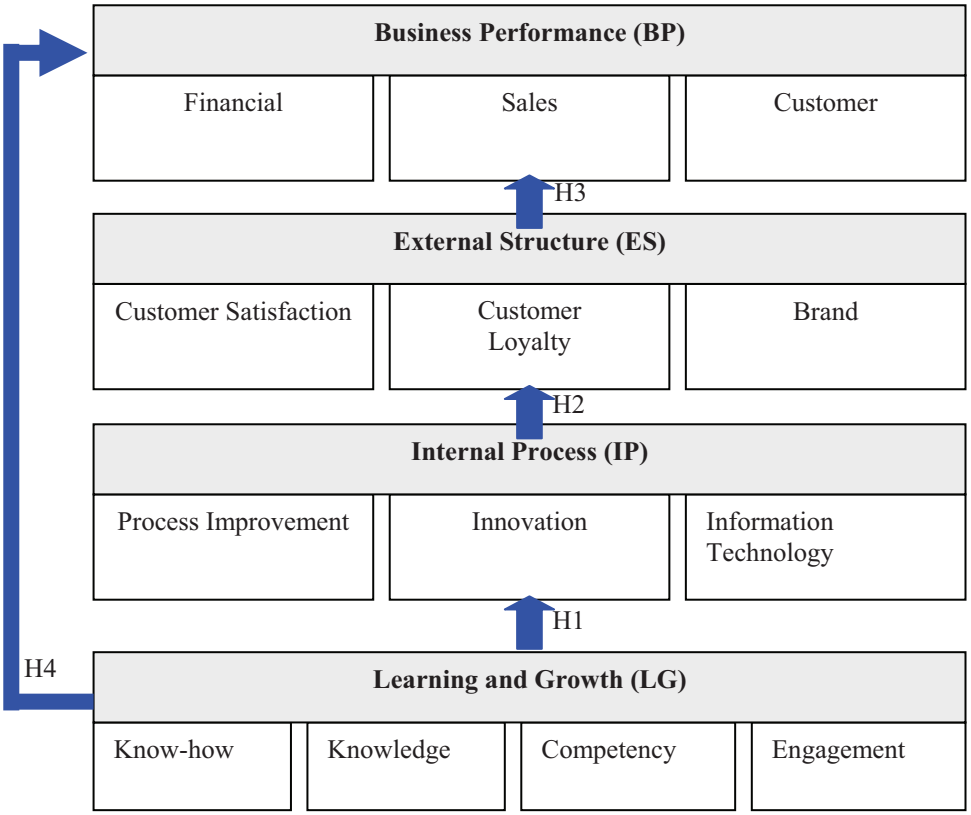

Figure 2 Research Hypotheses Testing Model

H1 : Learning and Growth is positively related to Internal process

H2 : Internal process is positively related to external structure

H3 : External structure is positively related to business performance

H4 : Learning and growth is positively related to business performance

There were several studies on the testing and accepted criteria. Accepted criteria in each statistical testing of previous studies, Steenkamp and Trijp (1991), Nunnally and Bernstein (1994), Ferguson et al. (2005), Hair et al. (2006) and Byrne (2006) shown in Table 4.

Table 4. Accepted criteria in each statistical testing

Testing	Purpose	Accepted criteria
Reliability assessment	Questionnaire consistency	Cronbach's alpha exceed 0.7 Item-total exceed 0.4
Convergent validity	Scale correlation with other measures of the same construct	CFI (Comparative Fit Index) exceed 0.9 NNFI (Non-Normed Fit Index) exceed 0.9 RMSEA (Root Mean Square Error of Approximation) lower than 0.05-0.08 AOSR (Average off-diagonal absolute standardize residual) lower value to zero, better fit *t*-value exceed 2.0 at $p<0.05$ Standard loading exceed 0.6
Discriminant validity	Construct different from the other construct	$\chi 2_{\text{constrained}} - \chi 2_{\text{unconstrained}} > 3.84$, $p<0.05$ correlation+2 (std. error) < 1
Hypotheses	Model fit	$\chi 2/_{df}$ Ratio between 1-3 CFI exceed 0.9 NNFI exceed 0.9 RMSEA lower than 0.05-0.08 AOSR lower value to zero, better fit *t*-value > ± 2.58, $p<0.01$ *t*-value >± 1.96, $p<0.05$ *t*-value > ± 1.65, $p<0.1$

Prior to doing the hypotheses testing, there are several testing steps as described in Figure 1. The detail of empirical result in each step is explained as follows:

Step 1: Field survey and Screening

Questionnaire was the primary source of data of this paper. An appropriate design of the questionnaire is crucial to ensure the success of the study and the achievement of the research objectives. The questionnaire in this paper is constructed by using the step-by-step procedure as illustrated by Churchill (1995). The questionnaires in each intangible assets indicator are adopted from the literature on the measures of intangible assets to business performance and constructed into a total of 68 questions. The questionnaire has to be clear and has simple wording before being dispatched and distributed to top managements of registered member companies in the Thai Chamber of Commerce. The members of the Thai Chamber of Commerce are in various types of industries and size of companies. They have reliable financial and general information. The questionnaires have been distributed to 3,084 members. There were 361 respondents. Some of them have incomplete information. The qualify respondents are only 304 which are used in further analysis. The next step of model testing procedure which is shown in Figure 1 is reliability assessment.

Step 2. Reliability Assessment

Cronbach's coefficient alpha provides an overall indicator of the correlations among a set of items used to measure a construct. It ranges from 0 to 1 (Hair et al., 2006). In general marketing and management fields, the Cronbach's coefficient alpha are accepted at minimum of 0.70 (Nunnally and Bernstein, 1994). However, before evaluating the reliability of scales, item-total correlations were initially calculated to purify the measures. The principle of this procedure is to indicate which items that do not belong to the content domain of the constructs. The items which exhibited item-total correlations below 0.40 were then eliminated from further analysis (Nunnally and Bernstein, 1994). There is only one question removed because it has lowest item-total correlations, 0.3. The Cronbach's alpha in this paper is shown in Table 5.

Table 5. Overall reliable assessment result

Intangible assets element	Intangible assets indicator	Cronbach's Alpha
Learning and Growth	Know-how	0.80
	Knowledge	0.72
	Competency	0.83
	Engagement	0.79
Internal Process	Process Improvement	0.79
	Innovation	0.85
	Information	0.81
External Structure	Customer Satisfaction	0.88
	Customer Loyalty	0.73
	Brand	0.88
Business Performance	Financial Performance	0.92
	Sales performance	0.93
	Customer fulfillment	0.87

All Cronbach's alpha are higher than 0.7. Therefore, on the basis of these preliminary analyses, each items seems to make a good contribution and sufficiently reliable. All questionnaires in each intangible assets element are consistent and reliable.

Step 3: Validity assessment

There are two types of validity assessment, convergent and discriminant validity. The convergent validity is to analyze the scale correlate positive with other measures of the same construct. Two models are tested in convergent validity analysis. The first model comprises 10 intangible assets indicators measuring 3 first order constructs/intangible assets those being learning and growth, internal process and external structure. Using the structural equation modeling, EQS program, all diagnostic indicators for the measurement model were satisfactory and suggested a goodness fit, (CFI 0.99, NNFI 0.98, RMSEA 0.08, AOSR 0.03, the lowest t-value 17.03 and lowest standard loading 0.82). The second model assesses the existence of a multi-dimensional business performance which is conceptualized and operationalized as a higher order construct composed of three first order dimensions those are financial performance, sales performance and customer fulfilling performance. Also, all diagnostic indicators for the measurement model were satisfactory and suggested a goodness fit, (CFI 0.96, NNFI 0.95, RMSEA 0.09, AOSR 0.05, the lowest t-value 8.3 and lowest

standing loading 0.63. Thus, the intangible assets indicator in each constructs/intangible assets is positive correlate with other indicators in the same construct. The knowledge, know-how, competence and engagement are positive correlate in learning and growth. Process improvement, innovation and IT are positive correlate in internal process. Customer satisfaction, customer loyalty and brand are positive correlate in external structure. Lastly, financial, sales and customer fulfillment performance are positive correlate in business performance.

The discriminant validity analysis is to analyze the degree of each construct variable different from other construct variable. In this study, there are 4 construct variables which are learning and growth, internal process, external structure and business performance. Structural equation modeling was utilized in the present study to assess the presence of discriminant validity among the study measures. The result of discriminant validity analysis is shown in Table 6.

Table 6 Discriminant Validity Analysis

Intangible assets elements	Learning & Growth	Internal Process	External Structure	Business Performance
Learning & Growth				
Internal Process	0.88 (0.02)[a] 141.51[b] 63.21[c]			
External Structure	0.79 (0.03) 105.71 54.72	0.88 (0.02) 85.12 30.23		
Business Performance	0.55 (0.06) 198.99 71.90	0.55 (0.05) 139.26 37.43	0.67 (0.05) 158.86 44.64	

Note: Entries below the diagonal show (a) ø coefficients, reflecting correlations among constructs and standard error in the parentheses (b) difference in chi-square from fixed (ø =1.00) model and free (ø estimated) model (c) chi-square for free model

The results in the above table indicate that, in all cases the pairs of construct variables were not collinear, which provide the evidence of discriminant validity. The each pair of difference constrained and unconstrained chi-square models is greater than 3.841 at p <0.05. In addition, each pair of constructs a confidence interval was calculated around the estimated correlation by using twice the standard error. Thus, both chi-square difference tests and confidence intervals assessment provide evidence of discriminant validity among the study constructs. Each construct variable is difference from other constructs. In this study, the intangible assets indicators in each construct variables (learning and growth, internal growth, external structure and business performance) do not correlate with each others.

Step 4. Hypothesis testing result

The result of 304 respondents in various business sectors, ago of business and size of business. The testing results in Figure 3 are simulated by EQS program.

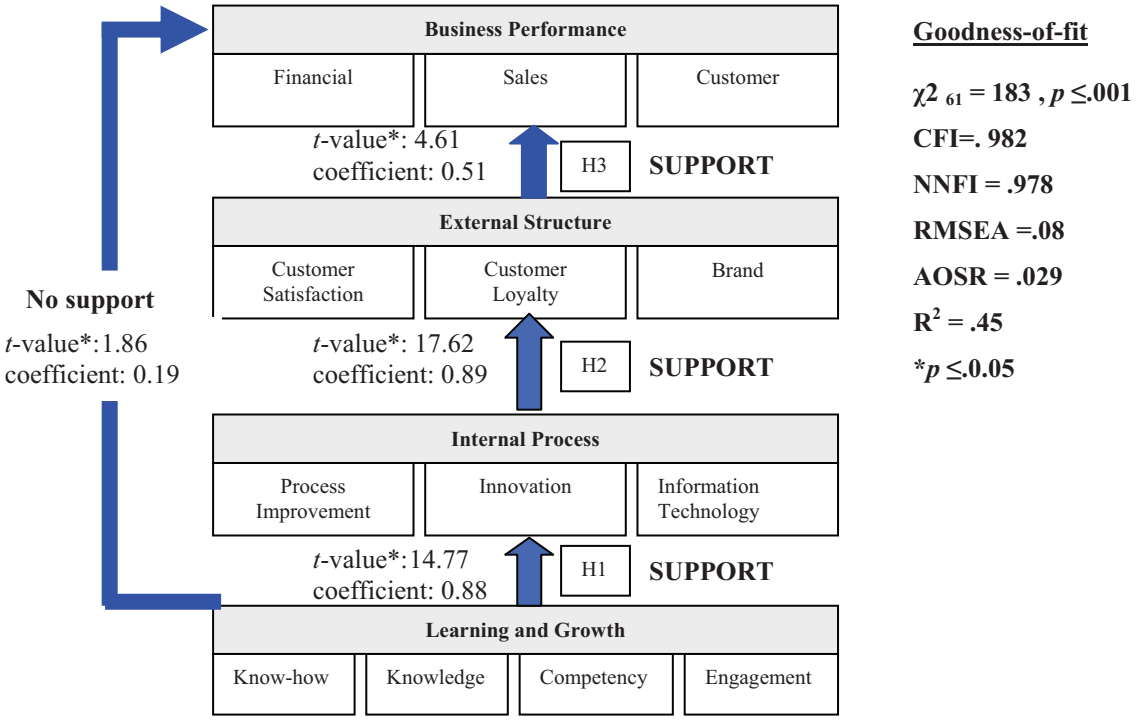

Figure 3. Structure model result

All diagnostic indicators show significant evident goodness-of-fit statistic, CFI=0.982, NNFI=0.978, exceeding 0.9. The RMSEA is equal to 0.08 and a small AOSR. With the large sample size, 304 respondents, the significant chi-square and degree of freedom ratio is acceptable. The model fits relative to the goodness-of-fit statistic result. All hypotheses are supported except the relationship between learning and growth and business performance at $p \leq .0.05$. This structural model solution produces an R^2 value of 0.45 which suggests that the structural model explains 45 percent of the variance in business performance. It has very strong explanatory power for this model compared with the previous studies in Carbrita and Vaz (2006) 0.44, Wang and Chang (2005) 0.43 and Bontis et al. (2000) 0.37.

CONCLUSION

Intangible assets are involved in all levels of value chain in business. The foundation of intangible assets in business is learning and growth. The knowledge, know-how, employee competence and engagement are the intangible assets in learning growth which are positive effect to internal process (process improvement, innovation and information technology) which is the same result as Wang and Chang (2005). The internal process is expended positive effect to external structure. Finally, external structure affects business performance. The learning and growth is the primary foundation factor to lead the business performance. The three elements of intangible assets are independent as illustrated in the validity testing. The linkage of three elements is confirmed the strategic mapping of the balance scorecard. The hypotheses testing does not support the cause-effect relationship between learning and growth to business performance. The learning and growth element has indirect effect to business through the value chain in balance scorecard, internal process and customer proposition.

MANAGERIAL IMPLICATIONS FOR INDUSTRIAL MANAGEMENT

No strategic recommendations were noted from past researches. Management practitioners need not only cause-effect relationship of the model testing results but also long term strategies in their business. When the top management or strategist realizes the cause-effect relationship of those three intangible assets, the recommendation strategies are discussed in the Figure 4. The recommended long-term strategies are retrieved from the high score question in each intangible assets indicators. Understanding the value of intangible assets help a business to develop sustainable and enhance its mission effectiveness and competitive advantage.

Intangible assets are the strategic key for long term profit prospect and sustainable competitive advantage. The setting of key performance index and investment has been allocated and monitored by the above guideline strategies. When the top management has crystallized strategies, they have good management and monitoring. Creating a culture of measurement-driven intangible assets and business performance helps top management understand how to drive the greater return from intangible assets investment.

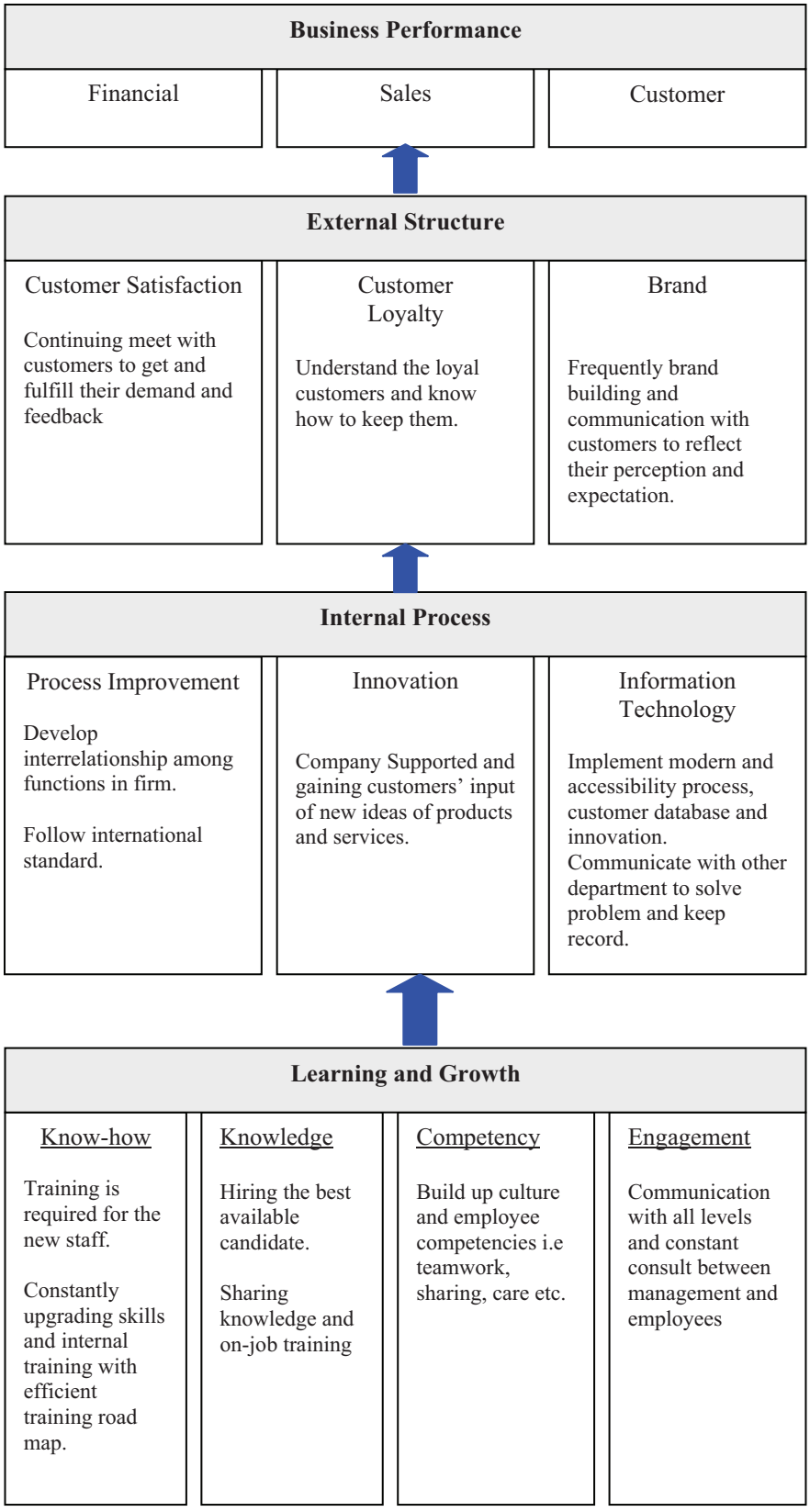

Figure 4. Intangible assets strategies to improve business performance

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HRIS EFFECTIVENESS USING DATA MINING TECHNIQUES.

Jayanthi Ranjan, Institute of Management Technology, Ghaziabad (U.P)-India
jranjan@imt.edu
Vishal Bhatnagar, Ambedkar Institute of Technology, Shakarpur, Delhi-India
vishalbhatnagar@yahoo.com

ABSTRACT

Organizations that are enlightened enough to recognize the importance and value of their data often have difficulty in actually realizing that value. Their data is often disconnected, inconsistent, and inaccessible. They have valuable, untapped raw data that is hidden in the reams of transactional data they collect daily. Information sharing among departments and functions is difficult. Unlocking the intelligence trapped in mountains of data has been, until recently, a relatively difficult task to accomplish effectively. HR data primarily concerns transactional processing-getting data into the system recording it for reporting purpose. Understanding the Human Resource (HR) data is vital to any firm's effective HRIS.

This paper studies the adoption of Data Mining techniques on HRIS (Human Resources Information System) in any organization and presents Data Mining with respect to HRIS effectiveness.

Keywords: Data Mining; human resource information systems; HRIS; human resource data; HR data; employees.

INTRODUCTION

Rapid technological advancements, globalization, move towards knowledge-based economy and a host of other trends are changing the face of any organization. This yields to have a major impact on the role of the human resources (HR) department [40]. An important innovation within the human resources management (HRM) function is the use of Information Technology (IT), which has led to the development of computer-based Human Resources Information Systems (HRIS). In fact, HRIS as described by [27] is the backbone of contemporary HRM function.

Studies have also reported that for organizations which have adopted HRIS, the investments are small and usually address tactics and administration rather than strategy. Tactical HR applications typically refer to transaction processing for payroll and benefits administration while strategic applications make organizations more effective and competitive, especially in knowledge management and workforce planning. In many organizations, the focus of the HRIS is on administrative efficiency. However, as organizations seek to grow and compete in the rapidly evolving knowledge-based economy, the pressure continues to grow for HR to play a strategic role in the organization [46]. The growing link between HR and business strategy has organizations looking to their HR professionals for innovative programs and practices to build a more competitive workforce.

The core and major challenges the corporate face in today's competitive environment is management of large volume of data filter the useful data and transform the filtered data into

useful knowledge. For this purpose, many firms have heavily invested in IT to help them to manage their business decisions more effectively and gain a competitive advantage. By implementing from Enterprise Resource Planning (ERP) to Customer Relationship Management (CRM), Supply Chain Management (SCM), and E-Commerce applications, the firms have taken a big step in automating their business processes [31]. Today all firms immediately respond replying as 'My People' when asked to specify the most important resources in their organizations. While lip service is given to the key human resource asset, surprisingly in reality, little time or effort is given into directing, conserving and leveraging that human resource asset. Data Mining, also called as knowledge discovery in large data, enables firms to make calculated decisions by assembling, accumulating, analyzing and accessing corporate data. Tools like query and reporting tools, On-Line Analytical Processing tools (OLAP), and Decision Support System (DSS) are used in Data Mining applications.

These organizations have been constructing their IT systems with nonintegrated single-point solutions. (For example, they have different departmental data warehouses built on different platforms using combinations of tools, some nonstandard, some with expired maintenance support, and some prebuilt in a tool purchased from a vendor no longer in business.) Implementing quick-fix solutions can become a software maintenance quagmire. With hindsight, even presumably researched software system purchases can still result in redundant tools, data inconsistencies, duplication of effort, and ultimately high IT operating expenses, with unintended barriers blocking systems from cleanly communicating among themselves. All organizations are reaching a point where it is important for computers to talk to other computers.

The concept and role of HRIS have increased parallel to business related technological advancements. All firms have realized and recognized that in a knowledge-intensive, innovative-or-die world; Human Resource Information System's role can not be limited to just administrative work of hiring and firing but has lot to do more. The HRIS also called as Human Resource Management Systems (HRMS) have become full fledged business advisors, beyond employee advocates. But while HRIS have appeared in increasing numbers as the cost of computing power has declined, many systems seem to have been acquired simply because they were affordable and not because organizations sought to use the computer as a means to more effective human resource management.

[25] described an understanding of how the Human Resource (HR) and the Information Technology (IT) management should complement each other for improved communication and competitiveness. [39] Emphasized on importance of organizational theory that makes difference while implementing Data Mining in an organization.

In a global competitive world, top management requires more and more information from their Human Resource (HR) departments. The management wants hard data on turnover, hiring, comparisons of compensation and benefits, ethnic, gender and cultural distributions to evaluate trends, anticipate possible changes in the workforce or the environment. It is necessary for HRIS to become more strategic, and more concerned with the quantifiable data. The objective of the paper is to highlight the role of Data Mining for effective HRIS.

The rest of the paper is organized as follows: In section II, related research is presented. I broadly describe the concepts of Data Mining in section III. Section IV discusses HRIS. Section V explains the techniques of Data Mining. Section VI describes effective HRIS using Data Mining. Section VII concludes the paper.

RELATED WORK

The concept of Data Mining is not explored more in context of HRIS. The work by [34] described the three major techniques of Data Mining namely Association, Clustering and Prediction on Human Resource (HR) data. [37] Presented the importance of Data Mining in Human Resource Information Systems and described thoughtful issues of HRIS with respect to Data Mining.

[43] Showed HRIS implementations lead to cultural considerations in any organization. [51] Described conflicts between information systems approaches and HRIS initiatives. [2] Mentioned that it is unfortunate that in the past many organizations have not gone beyond the automate strategy in HRIS developments.

[28] Explained the role of Data Mining applications on strategic and competitive advantage [41] points out on the patterns in human behavior to some extent for helping to predict how people will react to certain events. [36]) briefly discuss on the regression techniques, neural network applications in personnel performance and retention in Human Resource (HR) and personnel selection. [35] Stressed on the importance of information collection, transforming such information to patterns, for supporting decision making. [32] Mentioned the need for Data Mining for capturing knowledge in communities, for analyzing the co-occurrences of concepts, rules extractions, ontologies, classification grids etc. For HR effectiveness, investments in HR [30] are must for competitive advantage. [50] Presented various HR policies conceptualized by managers in an organization. [47] Suggested models for holistic knowledge framework in organizations. [23] stress on the value of performance measurements in organizations. [42] proposed the impact of training on the workforce for effectiveness in enterprise applications.

[53] described that Human Resource (HR) professionals are now able to give more time to strategic business decisions as the development of technology has allowed for the automation of many transactional HR processes. [3] Opinioned that the firm should put forward the organizational resources and capabilities that are usually rare, valuable, non-substitutable, and imperfectly imitable and these resources form the basis for a firm's sustainable competitive advantage. [8] Mentioned that HRMS create a sustained competitive advantage for decision making by hiring and developing talented staff and synergizing their contributions within the resource bundle of the firm.

[35]) suggest that some firms may use the data only for administrative purpose, some may transform this data into useful information, and some may analyze the patterns on the obtained information for support in decision making. [51] Described conflicts between information systems approaches and HRIS initiatives. It is unfortunate that as mentioned by [2] that in the past many organizations have not gone beyond the automate strategy in HRIS developments.

DATA MINING

Data Mining is the process of extracting information from large data sets through the use of algorithms and techniques drawn from the field of Statistics, Machine Learning and Data Base Management Systems [19]. Traditional data analysis methods often involve manual work and interpretation of data that is slow, expensive and highly subjective [18]. Data mining techniques track the data of the organizations that have thousands of employees a multitude of employment related information, extract the patterns contained in these HR databases by providing some insights like employee retention details, compensation planning, projecting risks and opportunity identifications and assessments.

In HR systems, for effectiveness, lots of data consolidation need to be done. Data Mining has a direct impact on the analytical results that will drive business decisions [5]. In understanding the employee, the complexity has increased dramatically because many departments, many employees, and many sophisticated tools have emerged in organizations. But with Data Mining, one can predict how likely someone will do something we are interested in, in real time [10]. It uses the extracted useful information from large data bases to make critical business decisions [10].

The applications of HRIS using Data Mining give opportunities to generate adhoc or standardized reports from specific sets of data. Researchers have established that [28] Data Mining applications when implanted effectively can result in strategic planning and competitive advantage. Data Mining as pointed out by [54] can be performed on a number of different databases and data repositories that include relational data, transactional data, data warehouse, web data, data streams, flat files, time series data etc. Data Mining includes various queries, reports and decision support tools based on historical data of the organization and can even predict for future perspective.

Organizations tend to write off Data Mining techniques since statistical analysis is routinely performed in all departments. The difference between Data Mining and Statistics is that Data Mining automates the statistical process resulting in several tools [5] Statistical inference is assumption driven in the sense that a hypothesis is formed and tested against data. Data Mining, in contrast is discovery driven. That is, the hypothesis is automatically extracted from the given data.

Some key employees unexpectedly quit in organizations, so how does a firm quickly fill the vacated positions. What do the organizations need to change and who should do it? Any firm's current workforce members are aging and set in their ways. There are patterns in why employees leave and these profiles can be applied to predict our current employees most likely to leave. The heart of the HRIS deals with retaining good employees and effective workforce planning to predict the needed number and types of skill sets of employees and expenses to meet future workload requirements. The reports received from HRIS describe various HR based reasoning like

- The groups of employees most likely to leave within the coming years.
- The reasons why employees have left in the past—measured by type of reason.
- Categories of people leaving by job type.
- Scores1 of individual employees (by name and employee ID number) in the high-risk category predicted to voluntarily leave.
- Current employees most likely to leave, broken down into categories, such as high, medium, or low risk, with the likely causes for their departure.
- Current top performers in the high-risk category and the percentages of reasons that historically caused separations of comparable positions and performers.

HUMAN RESOURCE INFORMATION SYSTEMS (HRIS).

HRIS in organizations collect basic personal and work related data in order to conduct basic HR transactions [35]. [29] give the core elements of Human Resource Information System comprising of HR application, recruitments, payroll, work flow management, reporting and analytics. HRMS can assess the best methods to meet future business objectives and learning needs of an organization with the help of DSS [17] by enabling the employees and managers to make fast, accurate, and informed personal and business decisions. [20] Provided information on reports pertaining to each HR activity like recruiting and placements, labor relations, compensation benefits that are regularly generated. [4] Founded that small firms are less likely to adopt HRM practices than medium or large firms. [33] Described the importance of Human Resources in enterprise systems. As per studies conducted [46] it is clear that for organizations which have adopted HRIS, the investments are small and usually address tactics and administration rather than strategy. However, as organizations seek to grow and compete in the rapidly evolving knowledge-based economy, the pressure continues to grow for HR to play a more strategic role in the organization [46]

[21] provide examples that include pay and benefits as a percent of operating expense, cost per hire, return on training and turnover cost. Mostly data obtained from HRIS do not provide an opportunity to seek additional relationships and patterns. For example, to assess the value of an employee who stays with the organization for an extended period of time, HR functions should provide information on the value of hiring than evaluating the cost of hiring etc.

The role of Data Mining in HRIS is to integrate various HR applications, collect data at various points in the HR databases, and use effective tools for making information available for effectiveness. Other role can be developing and improving intranet based applications for streamlining the processes, for improved predictions of employees' performance management, coordination and work flow management. Say, a separate process can be there for recruitment and selection, separate process for application tacking systems, in-house recruitments, process for training and development, performance management and also separate process for developing Employee Relationship Management. These systems help in consolidating the information across the enterprise to do everything from adhoc reporting to the analysis of complex relationships and workforce trends.

We can perform some of the interactive analytical modeling on HR data. We can detect trends and patterns in employee data which helps to further to improve the organizational culture and organizational decisions. The Decision Support Systems (DSS) can combine information from other functional areas within the firm, such as customer service and marketing, to help support HRIS decisions [9].

Generally patterns generated through Data Mining should be understood, should be valid on new or test data with some degree of certainty, potentially useful and novel. If one is searching long enough in any data set, it is possible to find patterns that appear to hold but are not necessarily statistically significant or useful [18]. A pattern will be interesting if it validates a hypothesis that the user sought to confirm. Data Mining is relevant to rank the discovered patterns according to their interestingness and filtering out the uninteresting ones ([15]. [7] Suggested that the choice of the Data Mining algorithm depends on the intended use of the extracted knowledge. Allocating man power based on demand projections requires careful task relevant data. According to the seasonal variations in demand, temporary man power can be hired to maintain service levels. The demand levels vary within one working day also, that can be used to allocate resources accordingly. Data quality may be insufficient if data is collected without any specific analysis in mind [19]. A careful process with respect to missing or noisy data is required. Whether the HRIS simply automates existing processes or supports transformational change will depend on the way it is designed and developed.

DATA MINING TECHNIQUES.

Data mining and analysis tools are designed to explore large quantities of data for comprehensive analysis to discover hidden relationships and uncover unknown patterns, trends, associations, or anomalies for the purpose of proactive or computer-automated decision making. These tools provide the ability to go beyond merely reporting *what has happened* in a business or organization to discovering *why it has happened*. They are also useful for deriving meaningful and accurate predictions. The superior data mining and analysis tools simplify and streamline both the data preparation time and the analysis process. The beauty of the data mining tools is that they enable organizations to create unique value on top of an asset they already have: their raw data. That is, the casual analyst is empowered with statistical, visualization techniques to extract the underlying business knowledge from vast deposits of data, exploit the data for predictive variables to yield validated findings, and conclusions, possibly optimize their decisions, and finally present the results in actionable forms such as customer segmentation models. Data mining provides a graphical user interface (GUI) that is designed such that analysts with only moderate statistical competencies can drive through the data mining and analysis process, while the quantitative expert can optionally go behind the scenes to fine-tune and tweak the analytical process. For example, nontechnical users can easily examine large amounts of data in multidimensional histograms to graphically compare their analyzed results derived from alternative scenarios and assumptions. The benefit is that the time delay from data access to action is dramatically shortened—and the results can be deployed across the Internet.

Associations, Mining frequent patterns.

These methods identify rules of affinities among the collections. [26] Mentioned that patterns occur frequently during Data Mining process. A frequently occurring subsequence such as staff movement and work attitude tend to have patterns in their performance. Another example in HRIS can be the claim forms submitted by the employees to the medical insurance of the organization. Every claim contains a set of medical procedures that were performed on the given employee during one visit. By defining the set of items to be 'the collection of all medical procedures that can be submitted' and the records to correspond to each claim form, the application can find, using association function, relationships among the medical procedures that are often combined together. Research shows [45] that association rules are essential beyond market basket analysis.

One can use association rules for application tracking mechanisms in recruiting, identification of patterns in employee benefits, analysis of staff movements etc.

Classification and Prediction.

The classification and prediction models are two data analysis techniques that are used to describe data classes and predict future data classes. A credit card company whose customer credit history is known can classify its customer record as Good, Medium, or Poor. To predict whether a certain employee will show a certain type of behavior implies an assumption that the employee belongs to certain type of employee group and will therefore show the certain kind of behavior. Extensive research has been done [6] on classification and decision trees.

The models of decision trees, neural networks based classifications schemes are very much useful for business decisions. Classification works on discrete and unordered data, while prediction works on continuous data. Regression is often used as it is a statistical method used for numeric prediction. While doing effective decision making for employee selection, selection of individuals to fill available jobs becomes clear and meaningful only when there are more applicants than jobs. Primary emphasis should be made on the selection measurement accuracy and predicative efficiency. Simple or multiple regressions is the basic prediction model that enables a decision maker to forecast each individual's criterion status based on predictor information.

There are procedures available to choose appropriate cutoff scores in employee selection processes. [49] Showed through case studies how neural network technology is useful from different areas of business. One can predict the likelihood of success in any HR process. Prediction and classification techniques are used in employee attrition rates(what type of employees are most likely to leave, most likely shift etc), factors to attract new customers, trends of movements of successful and unsuccessful trainings methods, predicting the percentage accuracy in employee performance etc.

Clustering.

It is a method by which similar records are grouped together. Clustering is usually used to mean segmentation. An organization can take the hierarchy of classes that group similar events. Using clustering, employees can be grouped based on income, age, occupation, housing etc. In business, clustering helps identify groups of similarities; characterize customer groups based on purchasing patterns, etc. An organization may segment the employees and discover clusters of potential employees on the basis of attributes (type of seminars, training programs attended and number of vacations availed etc). In HRIS, clustering can be applied to employees having similar characteristics, grouping top performers, analysis of workforce attrition and segments related to retirement facilities, compensations, benefits, allowances. Data Mining also provides summary information: various multidimensional summary reports, statistical summary information (data central tendency and variation).One can use historical data to build models of fraudulent behavior and use Data Mining to help identify similar instances. Good research is done [52] [38] [1][14][12] with respect to Data Mining in machine learning and large data sets.

EFFECTIVE HRIS USING DATA MINING.

In a global competitive world, the loss of an employee or an under-performing team of employees may literally make the difference between success and failure. With these circumstances, it is no wonder that top management has needed more and more information from their Human Resource departments. They demand hard data, information on turnover, hiring, comparisons of compensation and benefits, ethnic, gender and cultural distributions [13].

One can access aggregate reports on position vacancies, salary patterns, performance details, etc. Organization can identify the overall training budget if it wants to know what kind of impact it is having on the company. Data Mining can identify patterns of successful employees who have participated in the training programs, their further progress after training programs, their work performance, their promotions and progress after training programs etc. The generated patterns will be crucial to further training investments for the employees. [29] Mentioned the concept of HR analytics. Data Mining tools focus on [29] historic data and report past events, attempt to focus on trend forecasting in order to highlight areas requiring management attention. Such an approach can be very powerful when combined with a balanced scorecard approach to defining and monitoring key performance indicators in HR, although there is a significant overhead in setting up and maintaining such tools.

Researchers have shown that there is much significant relationship between employee attitude and employee performance [16] [44] [48] mentioned that in today's competitive environment where it is necessary for organizations to have effective HRM practices, the HRIS can support the recruiting, selection and training efforts of the organizations as well as monitor who is leaving the organization and for what reason. Data Mining can identify which segments groups are most successful, which offices and locations have responded to training well, which employee responds to what training etc. it is more economical to retain an existing employee than to acquire a new one. To develop effective employee retention programs it is vital to analyze the reasons for employee attritions.

For example, usually the impact(s) of a change, a training program or a pay increase for a group of employees have historically been projected is always based on educated opinion and not on statistical benchmarks. Often, these opinions turn out to be wrong. When that happens, significant investment has been made with no resulting benefit to the corporation. Newly trained workers may leave to join the competition. A pay increase may have no effect on turnover. To respond to the new demands and the increased visibility of HR management, HRIS seeks a strategic role by turning to Data Mining methods.

Another important factor to consider in the Data Mining process is interpretation of questionnaires pertaining to qualitative data of employees. For example, a pattern may be detected using Data Mining tool pertaining to an employee having the highest compensation level and extended long length of service. The interpretation may be different. Can we conclude that if employees stay long they will have higher compensation or they stay longer only for higher package? Domain knowledge is required along with expertise to interpret the cause and effects of the relationships generated by these patterns. As each company has its own HR data, the interesting relationships in patterns depends the company's competing market, growth cycle stage, integration of various HR applications etc.

We can build a model that identifies employees and their characteristics, who are frequently, been involved in particular, work assignments and tasks. There are some decisions that involve mathematical modeling and analysis which the management must take. Like, what is the proper size of the labor force in a large manufacturing organization? How many people should be hired to handle a significant new influx of demand or a large new contract? This involves mathematically rigorous conviction because the factors that influence productivity are usually not known very well. A properly designed analytical and mathematical model, using appropriate sufficient data could help managers to make better decisions about the level of human resources needed in a market characterized by significant changes in demand. Figure.no.1 shows how raw data in any organization transforms into optimized strategic business decision. The information process scenario is true to any HRIS. Rule based what-if scenarios, forecasting techniques based on analytical data can be applied to HRIS modules.

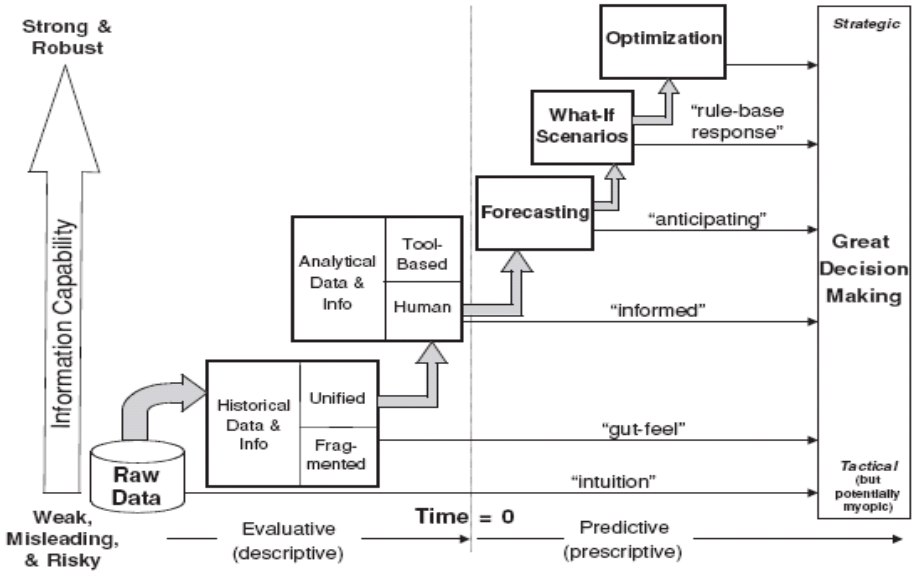

Fig.1 Data transformation into optimized business decisions (adopted from Cokins Gary (2004).

An important innovation within the human resources management (HRM) function is the use of information technology (IT), which has led to the development of computer-based human resources information system (HRIS). In fact, HRIS is the backbone of contemporary HRM function [27]. A HRIS is used to acquire, store, manipulate, analyze, retrieve and distribute pertinent information regarding an organization's human resources. Table 1.0 describes the difference between data, information and patterns of information that can be studied in an organization. The information capability based on know what, know how and know why is also provided.

	Process	Data	HR Reports	Training data	Employee Data
	Processing information in HRIS	**Information**	specializations data cross classified by training name, by employee name, by year	Training data cross classified by year, by course, by research project, by top performance.	Employee data-cross classified by top performance , training undertaken by year.
		Patterns of information using Data Mining	data showing interesting relationships or out of control categories; showing effectiveness in these data;	data showing interesting relationships or out of control categories; showing effectiveness in these data;	data showing interesting relationships or out of control categories; showing effectiveness in these data;
		Know-what	Ability to respond to a query; ability to assess symptoms of courses cancelled, correlations using statistics; identifying the best and popular training programs	Ability to respond to a query; ability to assess symptoms of training based on performance; correlations using statistics; identifying the best practices using expert systems.	Ability to respond to a query; ability to assess symptoms of employee' performance; correlations using statistics.
		Know-how	Ability to diagnose, analyze complex relationships using expert systems, Multi variate analysis of Variance using Statistics	Ability to diagnose employee attrition, analyze complex relationships using expert systems, Multi variate analysis of Variance using Statistics. Build competency and performance measurements tools.	Ability to diagnose students failures; Multi variate analysis of Variance using Statistics
		Know-why	Analysis of New programs, new employees , interdisciplinary work and thrust areas.	Employee communities of practice, personal assistance, group support systems, conference/seminars for sharing information.	Ability to deal with anomalies, interactive effects; use intranet based group support systems for assignments seminars, webminars and video conferences

Table 1.0 Representation of data and patterns of information in HRIS.

The power of data mining component, the robust analytical intelligence, is now available to business users in a compelling, easy-to-use format that is integrated with users' normal workflow. Feedback from analytics leads to corrective actions that positively impact business operations. Feedback guides decision-making, leading to actions that improve business performance. Rather than just reporting data, data mining HRIS introduces forecasting, modeling, and optimization capabilities for decision support. Analytics do not change the way people do business—they enhance how they do it. Data Mining tools are deployable across all levels of an enterprise, from top to bottom, and can be applied immediately to specific day-to-day business issues, such as with a customer call center, where information about each customer (e.g., account balance)

should ideally not only be current in real time but also suggestive of what action to take and why. The data mining tools deliver key metrics and precisely tailored information directly to casual users and decision makers. While enterprises will increasingly require these tools, complementing these capabilities with Data Mining applications substantially increases the overall value of their enterprise information and drives both sizeable productivity improvements across functional areas as well as profitable revenue enhancement. The primary goal of data mining in HRIS is to meld analytics with management functions so that data mining become an integral part of how managers and employee teams perform their job. Hence, successful implementation of data mining tools needs to focus first on specific business needs (i.e., supply chain management, customer churn detection and reduction, etc.).

CONCLUSION

In this paper, I have presented an interpretive perspective of techniques of Data Mining in HRIS by which organizations make sense of their vital HR data. I have also described Data Mining techniques with respect to HRIS. Organizations need to use HR data for strategic effectiveness. Data mining transform HR data into useful information and patterns to achieve competitive advantage. Careful and proper consideration and preparation of HR database, applying Data Mining Techniques will create an opportunity for firms to develop their competitiveness and effective decision making. I studied through Data Mining methods, once can measure the individual transactions and factors influencing an employee. Not all HRIS provide [24] integrated analytic features needed for compensation planning and decision support, such as the ability to also see related real-time competitive market salaries. Instead, they focus on database administration and record keeping related to compensation activities such as payroll, merit pay increases, and benefit enrollment. Migration and effective use of web-enabled integrated compensation design and analysis capabilities are still in their infancy [24]. The use of analytical HR software in all enterprises worldwide is very few.

We conclude that Data Mining on HRIS gives a better understanding of employee relations and improved employee satisfaction and higher probability of attaining competitive advantage. As the technology and techniques of Data Mining advance, organizations are able to collect, store, process, analyze and distribute an ever-increasing amount of HR data. Data and information are rampant in HRIS, but knowledge is scarce. As a result, most organizations today are governed by managerial intuition and historical reporting. However, we believe organizations are slowly moving to the knowledge age, where decision makers will leverage Data Mining technologies to augment intuition in order to allocate scarce enterprise resources for optimal performance. With proper preparation and consideration, HR databases together with data mining create an opportunity for organizations to develop competitive advantage.

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APPLICATION OF ENVIRONMENTAL CRITERIA IN ORGANIZATIONS ASSESSMENT WITH AHP METHOD

Dr Agnieszka Leszczynska, Maria Sklodowska Curie University, Poland
leszczynski1@poczta.wp.pl

ABSTRACT

An imperative to protect the environment leads to changes in the manner of activity and in the evaluation of a company. The results of the pro-environmental management of companies include green supply chains. Their effectiveness depends on the choice of particular links of a chain, considering not only efficiency indicators, costs, but also indicators concerning environmental management. The paper proposes the environmental criteria that may be used to evaluate companies and their products. Next, the procedure of expert assessment of companies using AHP method is presented. The evaluation is based on the general and particular environmental criteria, selected by a decision-making company from the group suggested by the author.

Keywords: environmental criteria, supplier assessment, AHP

"Traditional" measures of supply chain assessment

Increasing competition makes companies look for development opportunities by improving the management of supply chain both inside a company and along the line of contact of a company with its environment. Changes in a company management are oriented towards control and monitoring of the connections with outside partners, openness in cooperation, and synchronization of production processes, cooperative connections and market mechanisms (Piątkowski, Sankowski, 2005). A particular emphasis is placed on the development of effective connections, i. e. companies analyze costs they incur and effects of every activity in the chain generating value for a client, and strive to make possible improvements to increase profits. The result of such an approach is comprehensive assessment of cooperating companies.

According to the "traditional" approach, evaluation of cooperation partners is based on the logistic indicators representing empirically observable and measurable states of affairs which as adequately as possible describe the logistics aim or the aim system (Twaróg, 2003). These indicators are usually used to set aims and evaluate their implementation; however, they may also be applied in evaluation of the current data in order to monitor changes, play an advisory and control role (Kowalska, 1998). The traditional logistic measures can be most generally

divided into: the measures to assess the completion of a logistic process in the consecutive logistic chains, and the costs of logistic including:

- the measures to assess the efficiency of logistic activities (according to the flow stages),
- the measures of a company's own and external supply services,
- the measures to assess the duration of logistic activities in consecutive logistic chains.

The most popular of them include:

- price of a purchased product/service,
- product quality, supply quality,
- transfer time (time of delivery),
- punctuality of delivery,
- size of a maximum one-time lot,
- costs of transport, order handling, packaging,
- reliability and regularity of connections,
- scale of wastage,
- possibility to minimize the stored stock, e. g. using JIT,
- variability in time (flexibility of supplies),
- reliability of a supplier determined on the basis of one's own or others' experience,

financial condition of a supplier.

Because companies are characterized by specific requirements, expectations and preferences, the applied criteria undergo further internal differentiation (Bykowski, 1999). The comparison of offers is based on the scale methods, graphic methods.

The criteria mentioned above are used to assess potential cooperation partners and rationalize current activities in the area of logistics. The aim here is, first of all, to reduce costs, e.g. by adjusting the flow of materials along the logistic chain, and to increase the client's benefit, e.g. by increasing precision of delivery or reduction of transaction costs. These measures are thus supposed to be the basis in a decision-making process; they should provide companies with adequate sets of information needed to increase their competitiveness.

The criticism of traditional logistic measures and indicators follows from the fact that such measures are not strategic in character, and the connection between short-term measures and long-term results is not sufficiently clear. Moreover, most measurement systems are inflexible and do not take into account changes occurring in companies and their environment. This concerns also green supply chains whose development requires redesigned or completed system of traditional logistic measures. The next paragraph presents the concept of green supply chains. First, a set of environmental criteria that may be used in the supply chain management was presented, followed by a proposal of a possible application in economic practice.

Green supply chains

The development of the concept of sustainable development and increasing environmental requirements made ecological issues an essential component of contemporary companies management. This applies also to the function of logistics which includes establishing and development of green supply chains. Generally speaking, the concept of green supply chains is an organizational philosophy to make profit and reach market goals by reducing the environmental risk and impact and by improving the ecological effectiveness of a company and its partners (Zhu, Saris, Lai, 2008). Its gist is to incorporate the component of "greenness" into the traditionally understood supply chain, including provision, production and distribution. A broader understanding of the concept includes also product design and liquidation. Thus, the range of green supply chains encompasses designing environmentally friendly products, production using clean technologies, environmentally friendly packaging and transport, adequate procedures of product liquidation (remaking, recycling), etc.

The essential goal of green supply chains is a shared responsibility of cooperating companies for environmental results. Therefore, their participants promote reducing an impact on the environment by their own company and their partners. As a result, it is possible: 1) to reduce costs/benefits of environment-related activities, 2) to determine possible ways of reducing waste, 3) to reduce or eliminate waste inside a company (Handfield et al., 2002). Application of the concept of green supply chains to selected internal functions may also lead to: 1) using environment-friendly materials, 2) modernization of production process to make it cleaner, 3) ecolabelling, 4) ecological improvement of packaging and transport processes. An effect of such activities is an increase in the environmental results of a company, reduction of the risk of incompatibility with regulations and of environmental fines.

An assessment of suppliers by a company from the vantage point of the activity ecologization consists in making sure of the fact that materials and products suppliers provide are environmentally friendly and produced in the environment-friendly processes. Thus two main directions of "greening" the supply chain are related to evaluation of the environmental results and activities of suppliers and the latter's commitment to their improvement. The first direction consists in selection of criteria to assess suppliers (at the moment of evaluation). Another direction surpasses the routine assessment and monitoring, and consists in giving support to educational programs, creating environmental teams, implementation of environmental systems. The range of implementation of the green chain concept depends on the way it is perceived (it may be limited to a company's environment or incorporated into its internal functions) and on the level of ecological commitment of the company (on whether a company shows a pro-active approach to environmental management).

Environmental criteria of the company assessment

The main problem accompanying the development of green supply chains is determination of indicators to assess individual links of the chain. The logistic indicators described above, used in evaluation of the effectiveness of companies' logistic activities, do not provide sufficient information on environmental activities undertaken by companies, their environmental results, etc. Therefore, basing exclusively on the traditional logistic measures and indicators seems to a large extent insufficient in the case of green supply chains. Simultaneously, the research shows that one of the biggest problems encountered in the supplier evaluation and selection was which metrics to use to evaluate "greenness" (Handfield et al., 2002).

A solution to the above problem is to use the indicators related to environmental results, such as: the cost of environmental fees, CO_2 emission level, fuel consumption, water consumption, dangerous waste etc. This approach – no doubt the simplest – is based on the quantitative criteria. However, these measures were not always the most important metrics in terms of their impact on the environment.

Extending the group of criteria related to environmental results makes it necessary to include also the qualitative criteria in the evaluation process. This is a consequence of a multidisciplinary character of the environmental management concept, of the need to assess the effectiveness of logistic processes, both statically and dynamically, and also to evaluate the quality of services provided by business partners. Therefore, this paper proposes the multicriteria evaluation of suppliers on the basis of two groups of ecological criteria: 1) related to a company, 2) related to a product (Fig. 1).

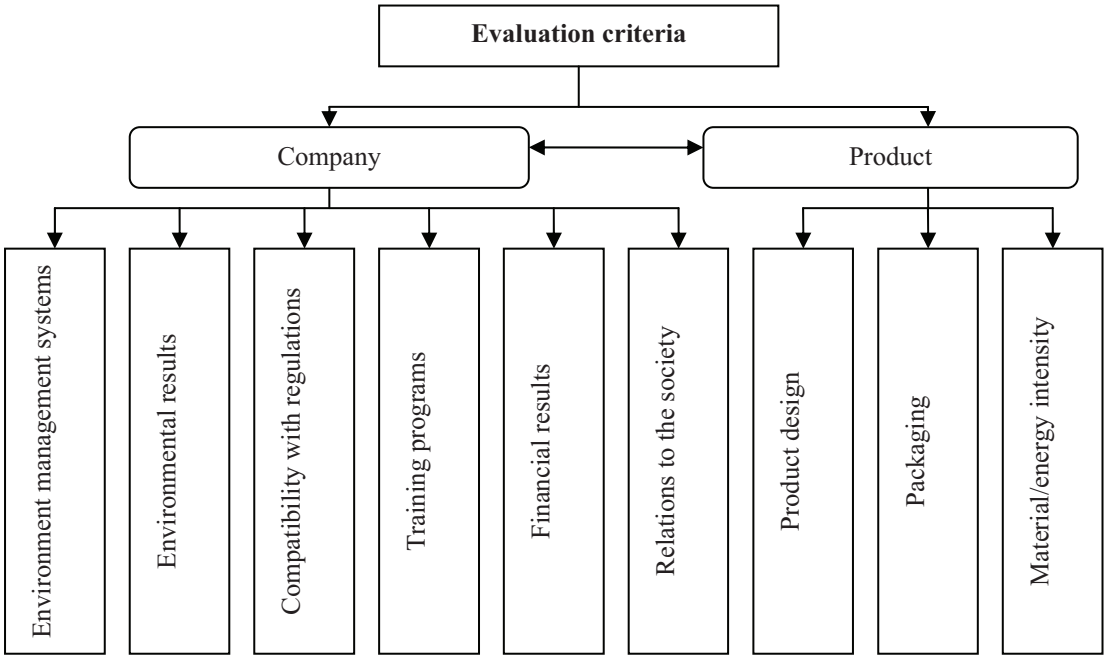

Fig.1. The proposed categories for environmental evaluation (Leszczynska, 2008)

The environmental evaluation of a company depends on the level of its "greenness", and covers: training programs, compatibility with regulation requirements, environment management systems, environmental results, financial results, and relations to the society. The assessment of products concerns the level of the product "greenness" and is determined by product design, packaging of the product, material/energy intensity; the number of categories may increase. The indicators used in each category are presented in Table 1.

Tab.1. The characteristic of environmental categories

Category	Description	Examples of the indicators
Environmental results	The category indicates the emission level, the size of generated waste and the range of use of natural resources.	Energy consumption Water consumption Quantity of waste
Environment management systems, environmental programs	The category refers to the extent to which the supplier's processes has been certified by the third party in the form of systems, i. e. ISO 14000, EMAS, and programs, goals and tasks related to the environment protection.	The scope of implementation of the environment management system The number of implemented pollution preventing initiatives The number of management levels with a definite environmental responsibility
Compatibility with the regulations	The category evaluates the extent to which the supplier's activities comply with environmental regulations (laws).	The time of reaction to environmental incidents Number of/ costs related to environmental fines, penalties
Training programs	The category focuses on the implementation of training programs related to environmental protection.	The number of hours of employee training on the advantages of …
Financial results	The category includes financial results related to the environmental aspects and activities of the company.	The costs related to environmental activities Return on capital invested in environment-improving initiatives
Relations to the society	The category determines involvement in the local environmental activities and contacts with the society/media	The number of enquires, commentaries on environmental issues The number of publications on the results of the company's environmental activity
Product design	The category determines the level of the supplier's involvement in designing environment-friendly products and in redesigning the existing products to eliminate the use of dangerous materials, or to meet the expectations of the so called „green clients".	The number of products planned for dismantling, recycling The number of products with instructions for environmentally safe use
Packaging	The category focuses on pro-environmental packaging, i. e. returnable, recycled, reusable packaging.	The share of recoverable secondary materials in protective elements
Material/energy intensity	The category determines the quantity of necessary materials (energy), including pro-environmental materials (i.e. recycled) in the production process.	% of materials coming from renewable resources in total materials Energy used per product unit

The criteria (indicators) used to evaluate cooperating companies may depend on the level of environment management in the company, on the goals of evaluation (decision-making process, obligatory documentation). For example, a company using the reactive strategy based on compatibility should focus on the indicators related to the degree of compatibility with legal requirements. On the other hand, a company adopting an innovative environmental strategy should take into account all the proposed categories. Moreover, the choice of logistic measures adequate for a given company should guarantee that they fulfill their proper function (advisory and/or operative). Therefore, the evaluation of a supply chain links on the basis of environmental criteria should be preceded by an analysis of the indicators referring to: the scope of tasks to be implemented, number and processing capacity, costs, etc.

The evaluation of supplier performance with AHP method

AHP method (*Analytical Hierarchy Process*) combines purely subjective expert evaluations with the objective analysis of decisions concerning hierarchically organized partial relations and connections among factors describing an analyzed problem. The method derives from the views of Saaty (Saaty, 1990) on the role of subjective evaluations, opinions in decision making. The subjectivity leads to ascribing different weights to partial parameters of each variant, which results in diversification of evaluation criteria. In this aspect, the method is analogous to the utility function (Kubiesz et al., 2008). In AHP method, decisions are analyzed in the framework of comparative or diagnostic evaluation, which leads to computation of the priority vector for the decision set or to application of the utility function the value of which is the basis for assessing dissimilarity of an analyzed problem. Thus the method adopts the multicriteria approach, based on the compensation strategy in preference modeling and assuming the comparability of variants, it takes into account the specific character of psychological processes of hierarchical and relational evaluation. Simultaneously, the method supports articulation of a decision maker's preferences and their use in the process of assessments aggregation. Modeling is used when unequivocal functional relationships among the problem components are not known and when the problem is described by a hierarchical structure of factors (criteria).
The evaluation of variants of an analyzed problem leads to a synthesis of partial results of those variants, described by a hierarchical set of criteria. The basis of AHP method is a hierarchical structure of goals, where the overriding goal is at the top of the hierarchy. The intermediate goals (criteria) are expressed by respective criteria of a lower level. Thus the structure of the problem of company-supplier performance evaluation takes the following form (Fig. 2):

- overriding goal – evaluation of suppliers' performance according to environmental criteria. Evaluation is performed by a decision-making company. In the author's study, it was a medium-size company producing chemicals, fertilizers, ethanol, titanium white;

- main criteria – the criteria selected from the group of the proposed environmental categories; seven criteria used in this study are presented in Table 2;
- partial criteria – the indicators chosen to evaluate the main criteria; the indicators used in this study are listed in Table 2;
- variants – the companies under evaluation. In this study: three companies (potential suppliers) active in chemical business.

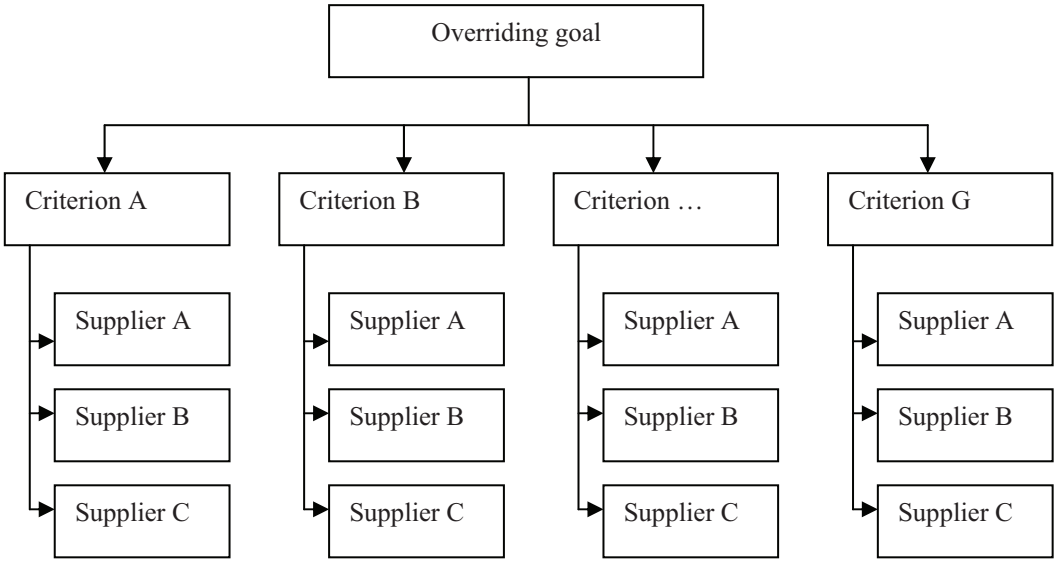

Fig. 2. Hierarchical structure of the problem

The procedure includes the comparison of all the factors in pairs to establish their mutual relationships. As a result, a matrix of subjective assessments is created, reflecting a degree to which a given company-supplier meets the relevant ecological criteria. The companies are evaluated on a conventional 1-7 scale.

Tab. 2. Criteria/indicators for evaluation of selected companies

Criterion	Indicators	Criterion symbol
Environmental results	Ammonium nitrogen, sulfates, COD, BOD_6, water consumption	A
Financial results	Environmental fees paid last year: water consumption, sewage disposal, emissions, waste storage	B
Environmental programs	Number of environmental programs planned for implementation in the next 3 years	C
Training programs	Number of employees trained last year in courses on ecological issues / general number of employees	D
Compatibility with regulations	Number of environmental audits performed last year	E
Relations with the society	Participation in pro-environmental initiatives in service of the society	F
Product design	Number of recyclable products/ general number of products	G

Analysis of the evaluation results

The analysis of the results was performed according to the specific AHP procedures. The first step was establishing, by the decision-making company, the relative importance of the selected criteria by evaluation of relationships between them, using the importance assessment technique. In this way, the matrix of comparisons for the degree of criteria preference was created on the basis of the company's preferences (Tab. 3).

Tab. 3. Matrix of the relative importance of the criteria

	A	B	C	D	E	F	G
A	1/1	7/1	2/1	5/1	3/1	2/1	5/1
B	1/7	1/1	1/5	3/1	1/3	5/1	5/1
C	½	5/1	1/1	5/1	5/1	3/1	3/1
D	1/5	1/3	1/5	1/1	2/1	1/5	1/7
E	1/3	3/1	1/5	½	1/1	1/5	1/5
F	½	1/5	1/3	5/1	5/1	1/1	2/1
G	1/5	1/5	1/3	7/1	5/1	½	1/1

The subsequent steps were the following:

- the relative importance of the criteria was decimalized,
- the square of the matrix was found,
- the values of elements of the new matrix were summed,
- the matrix of weights was found by sum normalization,
- consecutive iterations were performed on the basis of the above partial operations.

The weight vectors for the consecutive iterations of the performed operations are presented in Table 4.

Tab. 4. Results obtained for the selected criteria

Criterion	1st iteration	2nd iteration	3rd iteration	Order of criteria
A	0.297648	0.294767	0.296339	1
B	0.171752	0.140031	0.145734	3
C	0.232148	0.234428	0.234539	2
D	0.03294	0.039977	0.038389	7
E	0.067484	0.073089	0.072935	6
F	0.108947	0.117155	0.114516	4
G	0.08908	0.100553	0.097548	5

Next, the results obtained by each company-supplier for the selected indicators were collated (Tab. 5). The described procedure was used to determine the companies' preferences according to the criteria, and the number of criteria was reduced to the three most important: environmental results (1), environmental programs (2), financial results (3).

Tab. 5. Results of the suppliers for the selected environmental criteria

Index	Company A	Company B	Company C
Ammonium nitrogen [mg NH_4/l]	1.56	3.28	0.96
Sulfates [mg SO_4/l]	7.2	95.7	35.6
COD [mg O_2/l]	376.8	102.4	118.8

BOD_6 [mg O_2/l]	182.2	76.7	41.9
Water consumption [m^3]	4469917	128300540	57428933
Environmental fees [PLN]	56211234	33749916	48372391
% of trained employees	40	60	10
Number of planned environmental programs	8	5	1
Number of environmental audits	1	1	1
Participation in pro-ecological initiatives	2	1	1
Number of recyclable products [%]	33	60	33

Source: the author's own specification based on the information obtained from the companies.

The ranking of the preferred variants (companies) from the point of view of the individual criteria was put together on the basis of the computed (according to the previously described procedure) preference vectors (Tab. 6).

Tab. 6. Results of the generalized preferences

Environmental results	Environmental programs	Financial results
0.229505	0.64863	0.246801
0.121864	0.229505	0.436758
0.64863	0.121864	0.316441
2nd iteration	2nd iteration	1st iteration

The synthesis and interpretation of the solution is presented in Figure 3.

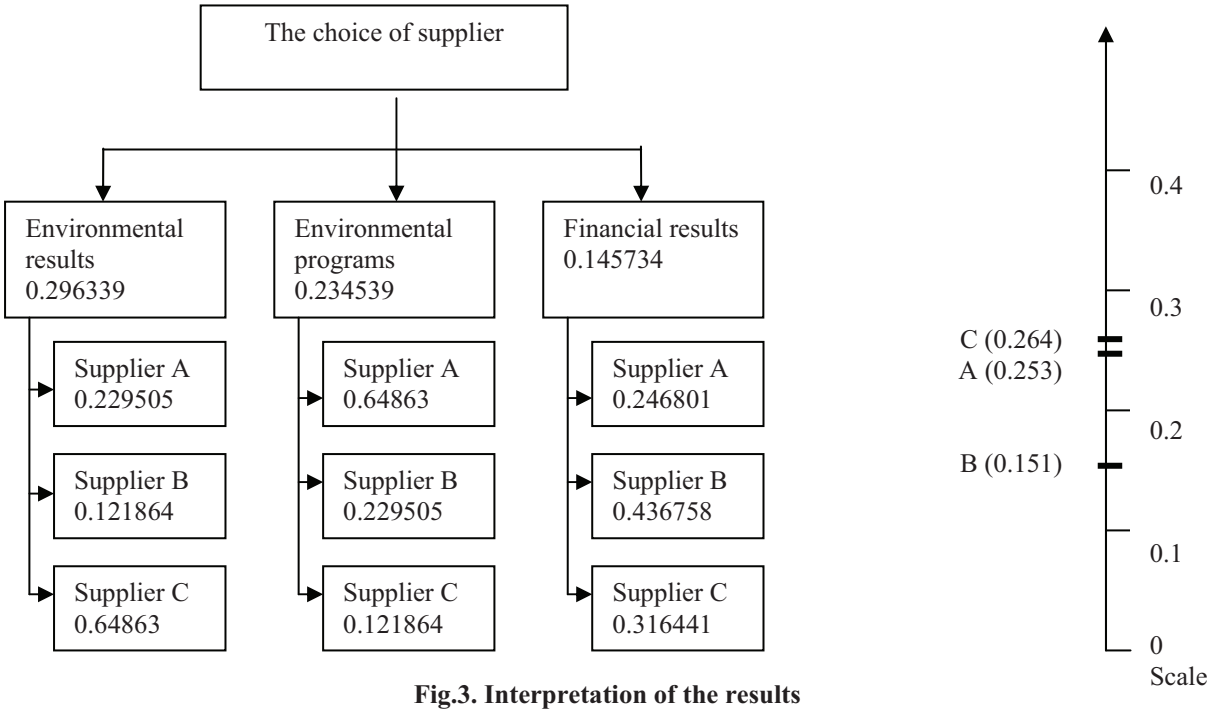

Fig.3. Interpretation of the results

CONCLUSION

The development of green supply chains results from a growing awareness and meaning of the environmental issues. Establishing of such chains entails the necessity of evaluation and

choice of suppliers who can proactively contribute to their company's environmental strategy and whose products and services meet or exceed government environmental regulations. This paper presented how the environmental measures/indicators can be used to evaluate links of green supply chains. The environmental criteria useful in evaluation of companies and products were proposed. The set of criteria may be extended by adding the logistic measures/criteria traditionally used by a company. Thus environmental indicators may be regarded as the ones complementing such "traditional" indicators as: proportion of orders accepted for realization, quality and time of delivery, flexibility of supplies, information openness etc.

The criteria presented in the paper were used to assess external suppliers. However, the presented indicators can also be used to evaluate a company's internal units. The identified indicators therefore satisfy the need for indicators that are useable both for an extended supply chain and for individual companies involved. The criteria were verified with AHP method, which was used to quantify the individual companies-suppliers.
Generalizing the study results, it should be stressed that the presented solution may be an efficient analytical tool in a decision process. This is due to the fact that AHP method makes it possible to determine the decision-maker preferences and to use them in the process of assessments aggregation. It may therefore be used in a multicriteria evaluation of cooperating companies on the basis of selected criteria.

A limitation of the presented solution is poor availability of the data. Resolving these types of issues is not an easy task. Much of the information needed for assessing environmental criteria is simply not available. In addition, companies are reluctant to give information on their internal activities. Other limitations result from the procedure of the AHP method application, and include a considerable subjectivism of judgments, necessity to meet the requirements of the method (e. g., possibility to perform operations on matrices).

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THE IMPACT OF ERP SYSTEMS ON INFORMATION FLOWS IN ENTERPRISES: A QUESTIONNAIRE SURVEY

Anders Haug, University of Southern Denmark, Denmark
adg@sam.sdu.dk
Anne Pedersen, University of Southern Denmark, Denmark
ape@sam.sdu.dk
Jan Stentoft Arlbjørn, University of Southern Denmark, Denmark
jar@sam.sdu.dk

ABSTRACT

The impact of ERP systems on the information flows of companies is an aspect often mentioned in ERP literature, but not a topic that has received much detailed attention. Based on existing ERP literature, this paper discusses the concept of ERP system integration in relation to how well the information flows in a company are organized around the ERP system. To investigate the level of ERP system integration in practice, the paper presents the data from a questionnaire study. The paper rests on the premise that ERP systems are designed as enterprise-wide repositories for master and transaction data, for which reason the intended utilization of an ERP system would imply that such companies are always capable of finding the necessary information when needed. However, data from the questionnaire indicates that this is not the case for many companies.

Keywords: Enterprise resource planning, ERP systems, Information flows, Information management

INTRODUCTION

Many companies have engaged in the use of ERP systems as a means to improve their competitiveness. Kumar et al. [16] describe the key underlying idea of ERP systems as "using information technology to achieve a capability to plan and integrate enterprise-wide resources, i.e. by integrating the applications and processes of the various functions such as design, production, purchasing, marketing, and finance". Basically, the popularity of ERP systems can be attributed to their promise of improving operational efficiency and business efficiency [8;13]. For many years, ERP projects have led to substantial tangible benefits (e.g. inventory reduction, less personnel needed, and reduced IT costs) and intangible improvements (e.g. improved internal processes, better customer service, strategic enhancements) in different areas of organizations [1;3;5;10;26]. On the other hand, achieving the expected benefits of the ERP system is by no means a guarantee in ERP projects. There are many examples of organizations that have not been successful in obtaining the intended benefits, in spite of making large investments in ERP projects [5;18;26]. Even worse, many ERP projects have failed and implied financial difficulties for these companies [20;28]. In fact, some research has indicated that ERP implementation projects commonly do not fulfil their initial objectives and operations often suffer from ERP related problems [11;17].

Although the implementation of an ERP system can produce significant performance benefits, achieving effective integration remains problematic because of the numerous technical and organizational challenges, such as the required standardization of work

processes, norms, skills, and outputs [2;12;15]. As formulated by Davenport [4], "an enterprise system, by its very nature, imposes its own logic on a company's strategy, organization, and culture". Because of the many built-in complexities in ERP projects, a significant amount of literature focuses on the management of ERP projects [11]. An important aspect in this context is redesigning the information flow structure of the company, i.e. defining how information processes should be altered to utilize the ERP system. The transition to using an ERP system (or extended use of an existing ERP system) affects the information flows in a company in a number of ways. From a principal perspective, the proper use of an ERP system as a common repository for enterprise data implies that relevant information can be retrieved by relevant persons. In other words, information flows should to a much greater extent pass through an enterprise-wide software system, rather than between individuals or groups in the form of oral messages, paper, emails, and local software systems. Guiding the information flows through a centralized and common channel ensures that information is always present when needed. This obviously implies a wide range of positive effects for a company, such as avoiding errors, shorter lead times, better basis for decision making, less redundant data, etc. Thus, such a transformation of the company appears to be something that should be a prioritized goal to any company. However, the question is if this actually is what happens in practice? Unfortunately, it seems that this topic is not something that has received much detailed attention in ERP literature [23]. Thus, this paper presents a questionnaire study carried out to investigate this question.

The remainder of the paper is organized as follows. Section 2 contains a review of relevant literature concerning the impact of ERP systems on the information flows of a company. Next, section 3 deals with the concept of ERP system integration. Hereafter, section 4 describes the method applied for investigating the impact of ERP systems in companies. Section 5 presents the empirical data from a questionnaire study, which are analysed and discussed. The paper ends with a conclusion in section 6.

LITERATURE REVIEW

This section investigates relevant literature in the context of analyzing the impact of ERP systems on the information flows of the company.

Effects of ERP systems on information flows

Mohania and Bhide [21] argue that the growth of organizations invariably leads to creation of multiple isolated data sources that are disconnected from each other, which leads to reduced efficiency. They further claim that the information integration problem has become the biggest pain point for enterprises today. Vayghan et al. [27] describe the concept of 'information silos', which means that data are redundantly stored, managed, and processed in different silos with different policies and processes. Thus, inconsistency often occurs. Vayghan et al. argue that enterprises need to move away from the 'information silo approach' and towards integrated management systems and architectures for data, processes, and policies.

ERP systems have been marketed as a panacea for dealing with lack of data integration, i.e. that replacing inadequately coordinated legacy systems by an ERP system should imply that most data quality problems would disappear [4;14;18]. However, it is important to perceive ERP as more than integration of IT systems, but to a great deal also business integration, i.e.

defining how the functional units of a company are linked to one another through data/information and processes. In other words, implementing an ERP system implies data and process integration. Organizational information processing theory suggests that ERP systems fit organisations where the interdependence is high and differentiation is low [8]. Thus, Gattiker and Goodhue [8] argue that there is a tendency towards organisational subunits that are highly interdependent to substantially benefit from an ERP system, while subunits that are very different from the other subunits may incur costs from dealing with suboptimal business processes or dependence on employee workarounds. The great danger of having a low fit between some organisational units and the ERP system is that such units use other software than the ERP system for some operations, and thus the purpose of information integration in the company is counteracted. To limit such negative impacts, the information flows of all relevant business units should be thought into the ERP solution.

One of the primary goals of managing the information flows in ERP projects is to ensure that the ERP system provides the needed data to relevant users and that data are of adequately high quality. In this context, Vayghan et al. [27] describes three important data-specific challenges: (1) establish trusted data sources; (2) integrate information; and (3) improve data quality. For the first challenge (establishing trusted data sources for enterprise-critical data), they argue that this becomes a major challenge if: the ownership of data is fragmented in many areas; there are multiple sources for the same data; existing data are undocumented and tightly coupled inside monolithic applications; and subject matter experts in these areas are in short supply. For the second challenge (problems of integrating information), they describe this as being caused by: platform dependencies; organizational issues; tight coupling with business processes; and the lack of business data standards. For the third challenge (improvements of data quality), they argue that this is increasingly difficult: when dealing with a large amount of data where data fields are not standardized; if there are multiple ways of capturing the same data; and if data is copied in many places.

The importance of information flow management

To highlight the importance of aligning the information flows of a company with their ERP system, this issue can be related to the type of benefits that an ERP system produces. Shang and Seddon [24] provide a classification of ERP benefits into five groups: 1) operational (cost reduction, cycle time reduction, productivity improvement, quality improvement, and customer services improvement); 2) managerial (better resource management, improved decision making and planning, and performance improvement); 3) strategic (supporting business growth, supporting business alliance, building business innovations, building cost leadership, generating product differentiation, and building external linkages); 4) IT infrastructure (building business flexibility, IT cost reduction, and increased IT infrastructure capability); and 5) organizational (supporting organizational changes, facilitating business learning, empowering, and building common visions). For all these types of benefits, the precondition is that the necessary information can be found in the ERP system. The more frequently information cannot be found, the less are the benefits of the ERP system.

Markus et al. [19] differentiate between three distinct phases in the ‘ERP experience cycle’: 1) project phase (configuration of ERP software and roll out in organization); 2) shakedown phase (the company makes a transition from 'go live' to normal operations); and 3) onward and upward phase (the company captures the majority of business benefits and plans future steps). In all three phases it is important to ensure that the information flows of the company

are aligned with the ERP system. However, the 'battle' is not lost if this alignment is not achieved instantly. Although the adequate alignment of the information flows with the ERP system is not achieved during the project phase, it can later be achieved during the shakedown phase. In the onward and upward phase, a focus on ensuring that healthy information processes are maintained is important in order not to lose the benefits obtained.
Another danger in ERP projects, besides not getting the required data/information into the ERP system, is that the data stored in the ERP system may be incorrect. Incorrect data is a problem that does not only affect the context in which they are used, but also may have much wider ranging consequences if data errors are carried throughout the system [9]. According to Häkkinen and Hilmola [11] marginal data inaccuracies (e.g. 1-5 percent) may not necessarily represent a major problem in manufacturing, but such inaccuracies will have direct effects in terms of lost sales and operational disruptions in the after-sales organizations. However, ensuring that the data stored in the ERP system is correct is an easy task. According to Knolmayer and Röthlin [14], capturing and processing master data involves several risks of errors, which can emerge from: inappropriate information system architectures, insufficient coordination with business processes, inadequate software implementations, or inattentive user behaviour. Knolmayer and Röthlin give the example that if an employee does not find required master data within reasonable time, the employee may be tempted to swiftly create duplicate data in order to continue his business tasks. Other common sources of errors, which may contribute to misunderstandings or data redundancy, are mistyping names, addresses, and other data fields.

ERP SYSTEM INTEGRATION

In literature there seems to be general agreement on the meanings of the terms 'data' and 'information', while the meaning of the term 'knowledge' is much debated (see e.g. [7;22;25]). However, in this paper the focus is on data and information. Davenport and Prusak [6] define data as "discrete, objective facts about events" and information as data transformed by the value-adding processes of contextualisation, categorisation, calculation, correction and condensation. Similar definitions of data and information are provided by Zack [29], "data represent observations or facts out of context, and therefore not directly meaningful. Information results from placing data within some meaningful context, often in the form of a message". In a similar vein, Newell et al. [22] define data as "providing a record of signs and observations collected from various sources" and information as when "data are presented in a particular way in relation to a particular context of action".

Much of the information passing through a company has relevance for others than the ones initially sending it and the ones receiving it. An ERP system can be the medium that ensures that such information is stored and made accessible to others. Therefore, an important focus of ERP projects is to force this communication of important information through the ERP system. To highlight the difference between structured and unstructured information flows, Figure 1 illustrates a scenario where structuralization of information flows implies that all relevant employees have access to the information they need. In the scenario on the left side of Figure 1, Actor-1 passes on information to Actor-2, while Actor-1 and Actor-2 fail to recognize that this information is also needed by Actor-3. In the scenario to the right, Actor-1 communicates to Actor-2 through an ERP system (i.e. stores data that Actor-2 finds), which enables Actor-3 to use this data as well. The type of data/information in focus in the described scenarios could be transaction data (e.g. invoice payment, receiving of ordered

items, etc.), master data (e.g. item name, debtor credit limit, etc.) or various business information (e.g. budgets, project plans, etc.).

Using the two scenarios illustrated in Figure 1, three archetypical information flow configurations can be defined with respect to ERP system integration, as shown in Figure 2. In Figure 2, the circles represent persons and groups, while the arrows represent communication of business information. As seen, the higher percentage of relevant information, which is exchanged through the ERP system, the more integrated the ERP system is. This measure indicates how well information is shared in an organisation, i.e. the higher the integration of the ERP system is, the greater the chance of being able to find needed information for the users of the system. Thus, 'full enterprise system integration' may at first glance seem to be the solution to all information problems. However, just because information is accessible, this does not mean that it is useful. The stored data also has to be of adequately high quality, i.e. correct, unambiguous, consistent, etc.

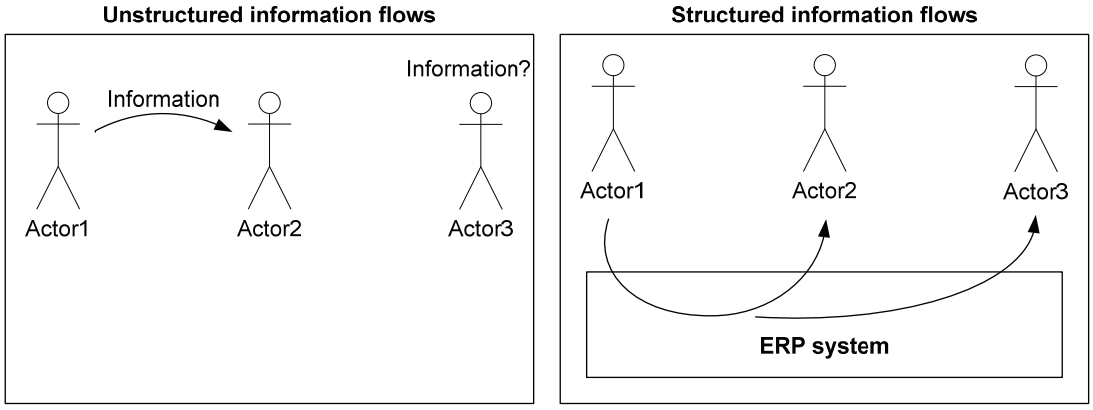

Figure 1: Unstructured vs. structured information flows

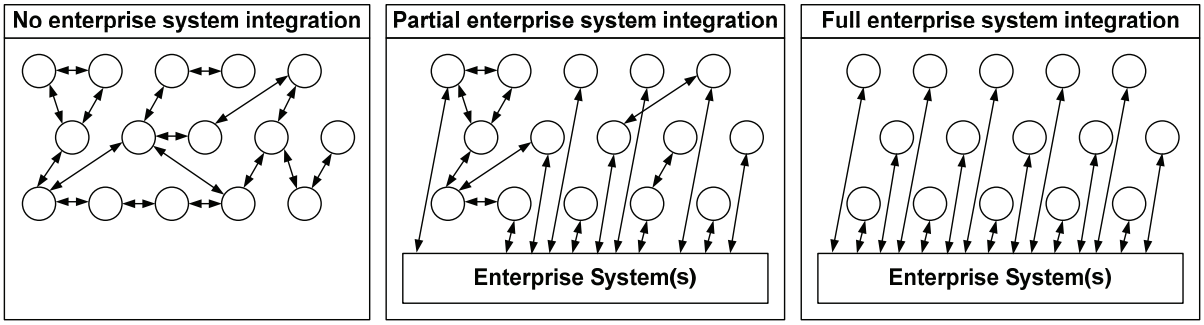

Figure 2: Levels of enterprise system integration (lines symbolize information flows)

RESEARCH METHOD

In 2008, a questionnaire study focusing on supply chain management was carried out. Part of the questionnaire had a focus on information systems within and across companies. The data from this part of the study are presented in this paper.

The questionnaire survey was conducted by distributing questionnaires to 110 of the participating companies at a Danish supply chain meeting ("The Supply Chain Day") arranged by the Danish post office "Post Danmark". This resulted in 49 completed questionnaires. The data were cleansed for companies not having an ERP system and for incomplete responses. This left 37 useable answers divided into 23 manufacturers, 10 wholesalers and 4 retailers. To be able to make a reasonable comparison of companies, it was decided to focus only on the companies of the type 'manufacturers'. This choice was made based on the assumption that such companies in general deal with greater challenges of data management because of dealing with both purchased/produced components and end-products. Table 1 shows the sizes of the remaining companies, divided into small companies (1-49), medium sized companies (50-249), and large companies (250 and more).

Size	1-49	50-249	250-	Total
Number	5	8	10	23

Table 1: Company sizes

RESULTS AND DISCUSSION

The questions about information management were organized into three areas, which are presented in the following sub-sections:

- Product development and production planning
- Deliveries from suppliers
- Deliveries to customers

Product development and production planning

To investigate the extent of the information management problems during product development and production planning, the respondents were asked to estimate how often needed information cannot be found and how often misunderstandings occur because of inconsistent information. Table 2 shows the frequency of needed information that cannot be found during product development and production planning and Table 3 shows the frequency of misunderstandings because of inconsistent information during product development and production.

Frequency/Company size	1-49	50-249	250-	Total
1. Never	20.0 %	12.5 %	20.0 %	17.4 %
2.	40.0 %	75.0 %	50.0 %	56.5 %
3.	40.0 %	12.5 %	30.0 %	26.1 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 2: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never	0.0 %	12.5 %	0.0 %	4.3 %
2.	100.0 %	37.5 %	60.0 %	60.9 %
3.	0.0 %	50.0 %	30.0 %	30.4 %
4.	0.0 %	0.0 %	10.0 %	4.3 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 3: Frequency of misunderstandings because of inconsistent information

The data show that for the majority of the companies, there do not seem to be great problems in relation to the handling of information during product development and production. In the dataset, 17.4 percent do not experience that information cannot be found, and 56.5 percent chose the rating '2'. For the remaining 26.1 percent who gave the frequency rating '3', the frequency of experiencing that information cannot be found cannot be considered satisfactory. A similar picture is shown from the frequency of misunderstandings occurring because of missing information, although happening a bit more frequently, i.e. 30.4 percent placed this at the frequency '3' and 4.3 percent at '4'. However, the problematic 26.1 percent in Table 2 and the 34.7 percent in Table 3 may be explained by other factors than just poor ERP system usage, since other systems often also are used together with an ERP system for the management of product and production information.

Deliveries from suppliers

To investigate the extent of the information management problems during the process of managing deliveries from suppliers, the respondents were asked to estimate how often needed information cannot be found and how often misunderstandings occur because of inconsistent information. Table 4 shows the frequency of that needed information cannot be found during the process of handling deliveries from suppliers, and Table 5 shows the misunderstandings because of inconsistent information during the management of deliveries from suppliers. In the questionnaires handed out, examples of the types of information in focus were included, i.e. amounts, quality descriptions, prices, item numbers and similar.

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	44.4 %	27.3 %
2.	80.0 %	75.0 %	33.3 %	59.1 %
3.	0.0 %	12.5 %	22.2 %	13.6 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 4: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	0.0 %	22.2 %	13.6 %
2.	40.0 %	87.5 %	44.4 %	59.1 %
3.	40.0 %	12.5 %	33.3 %	27.3 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 5: Frequency of misunderstandings because of inconsistent information

The data show that 27.3 percent of the companies never experience that they cannot find the information needed during handling of deliveries from suppliers, while 59.1 percent rated this '2'. Only 13.6 percent experience not being able to find the needed information at a frequency of '3'. The frequency of misunderstandings because of inadequate information rated '3' is a bit higher, i.e. 27.3 percent. Therefore, the data show that it is only a smaller part of the companies which have problems during supplier handling. In these cases, however, there is a strong indication of unsatisfactory ERP system integration, since ERP systems are intended to hold all relevant information related to suppliers and purchases.

Deliveries to customers

Next, the extent of the information management problems during the process of managing deliveries to customers was investigated. In the context of management of deliveries to customers, Table 6 shows the frequency of lost information, Table 7 shows the misunderstandings because of inconsistent information and Table 8 shows the frequency of how often the delivery times are not kept because of inconsistent information. In the questionnaire handed out, examples of the types of information in focus were given, i.e. completed orders, ongoing orders, time of delivery, order size and similar.

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	0.0 %	20.0 %	13.0 %
2.	60.0 %	62.5 %	60.0 %	60.9 %
3.	20.0 %	12.5 %	10.0 %	13.0 %
4.	0.0 %	12.5 %	10.0 %	8.7 %
5. Very often	0.0 %	12.5 %	0.0 %	4.3 %

Table 6: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	0.0 %	8.7 %
2.	60.0 %	50.0 %	70.0 %	60.9 %
3.	0.0 %	12.5 %	10.0 %	8.7 %
4.	20.0 %	25.0 %	20.0 %	21.7 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 7: Frequency of misunderstandings because of inconsistent information

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	10.0 %	13.0 %
2.	60.0 %	37.5 %	60.0 %	52.2 %
3.	20.0 %	25.0 %	10.0 %	17.4 %
4.	0.0 %	25.0 %	20.0 %	17.4 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 8: Frequency of not keeping promised time of delivery because of inconsistent information

Table 6 shows that 13.0 percent never experience that they cannot find the information needed during handling of deliveries to customers, 60.9 percent gave the rating of '2', while 26 percent gave a rating from 3 to 5. In Table 7, 29.4 percent of the companies gave a rating from 3 to 5. Assuming that ratings of 3 to 5 are problematic, the data show that for more than a fourth of the companies there are problems in the handling of information related to deliveries to customers. With regard to being able to keep the promised time of delivery because of inconstant information, as seen in Table 8, for 17.4 percent this happens at a frequency of '3', and for 17.4 percent it happens at a frequency of '4'. The data from this part of the questionnaire indicate that these around 35 percent of the companies have unsatisfactory ERP system integration, since ERP systems are intended to hold all relevant information related to deliveries.

Information problems across processes

In order to show how many companies experience information problems in any of the three processes, in Table 9 is found a summation of the total number of the companies who in any

of the three processes (i.e. product development and production, deliveries from suppliers, and deliveries to customers) experience that needed information cannot be found.

Frequency of that needed information cannot be found in: product development and production; deliveries from suppliers; and/or deliveries to customers	Companies
1 Never	13,0.%
2	39.1 %
3	34.8 %
4	8.7 %
5 Very often	4.3 %

Table 9: Frequency of that needed information cannot be found in any of the processes

Assuming that ratings from 3 to 5 of how often the needed information cannot be found can be classified as being problematic, about half of the companies (48%) have information management problems in spite of having an ERP system.

Forms of communication

To investigate possible reasons for problems of managing information, the companies were asked to tell how often different forms of communication are used. Table 10 shows the way information is communicated during product development and production planning, and Table 11 shows the way information is communicated during the process of handling deliveries from suppliers.

Frequency of communication form	Email	Software	Printed documents	Handmade documents	Speech
1. Never	13.0 %	4.3 %	8.7 %	52.2 %	17.4 %
2.	13.0 %	8.7 %	30.4 %	21.7 %	26.1 %
3.	26.1 %	13.0 %	17.4 %	17.4 %	30.4 %
4.	17.4 %	17.4 %	26.1 %	8.7 %	17.4 %
5. Very often	30.4 %	56.5 %	17.4 %	0.0 %	8.7 %

Table 10: Product development and production planning: communication forms

Frequency of communication form	Email	Software	Printed documents	Handmade documents	Speech	EDI
1. Never	0.0 %	45.5 %	8.7 %	72.7 %	18.2 %	50.0 %
2.	0.0 %	18.2 %	30.4 %	18.2 %	9.1 %	9.1 %
3.	8.7 %	18.2 %	21.7 %	0.0 %	50.0 %	18.2 %
4.	21.7 %	9.1 %	34.8 %	4.5 %	13.6 %	22.7 %
5. Very often	69.6 %	9.1 %	4.3 %	4.5 %	9.1 %	0.0 %

Table 11: Deliveries from suppliers: communication forms

With regard to the way information is communicated during the product development and production process, the majority of the companies very often use software to handle this communication, i.e. 56.5 percent. However, the numbers also show that a significant part of this communication is in the form of printed documents, handmade documents and speech. These numbers provide a possible explanation to the problems reported with regard to not being able to find the needed information in this process. In the communication in connection with handling the deliveries from suppliers, email is by far the most used means of communication, i.e. 69.6 percent stated 'very often'. However, information is also to a large extent exchanged by speech, which may be part of the explanation for the amount of lost and inconsistent information reported.

CONCLUSIONS

In much literature ERP systems are described as a technology that promises integration of business information across the business units of a company. However, also much literature points out that this does far from always happen in practice. One of the main obstacles is that such a transformation requires great alterations of the information flows of the company to insure that information passes through the system and not past it. To deal with this topic, this paper discussed how ERP projects can transform the way that business information flows through a company. The paper presented three archetypes of enterprise system integration: 'no integration', 'partial integration', and 'full integration'. These types are relevant in the sense that the degree of ERP system integration in many ways is decisive for the amount of benefits that a company can achieve from an ERP project.
Having defined different levels of ERP system integration, a question to be raised is that although many companies manage to implement ERP systems into daily operations, do they actually achieve a satisfactory ERP system integration, i.e. a proper restructuring of the information flows within the company? To investigate this issue, the paper presented a questionnaire study from where the companies of the type 'manufacturer' and the ones that use ERP systems were selected, in all 23 companies. The data from these companies indicate that about half of these companies have problems in managing their business information, in spite of having an ERP system. However, the data from the conducted study should be received with some reservations. First, it should be recognized that the amount of data retrieved fitting the selection criteria (i.e. manufacturers with ERP systems) was not very extensive for a study of this kind. Therefore, the study does not give a solid basis for generalization about the quality of information management in Danish manufacturing companies with ERP systems. Another problem of the study is that the way the questions were asked left much to the judgement of the respondents. Also, since only one person from each company filled out the questionnaire, there is a great chance that others in the same organization may have insights into other problems of handling information. Thus, it seems fair to assume that the numbers would have been higher if more persons from each company had answered the questionnaire.

Since about half the companies in the survey reported not being able to find the relevant information at a frequency that seems unsatisfactory, there are some indications of problems related to ERP system integration. This produces two main challenges for future research. First, a more extensive survey needs to be carried out in order to produce better grounds for generalizing. Second, more in-depth studies are needed in order to discover the reasons for the apparent problems of integrating ERP systems in companies.

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EVALUATING PRODUCT-SERVICE SYSTEMS USING SYSTEM DYNAMICS

Ms. Sora Lee, Seoul National University, Korea
soralang@snu.ac.kr
Ms. Jieun Kim, Seoul National University, Korea
hsns1234@snu.ac.kr
Dr. Chulhyun Kim, Induk Institute of Technology, Korea
stddevs@induk.ac.kr
Dr. Yongtae Park, Seoul National University, Korea
ytpark@snu.ac.kr

ABSTRACT

Product-service systems (PSSs) are highlighted as prevailing trend toward integration of products and services for customer satisfaction or sustainability. Many firms have chosen PSSs as an essential strategy to survive in hyper-competition. However, few systematic methods for evaluating PSSs from multi-objective perspectives have been established. This study proposes a systematic approach to evaluation of PSSs using system dynamics from multi-objective perspectives such as customer satisfaction, sustainability, and profitability. System dynamics is a method developed to support the dynamic behavior in complex systems. It can be effectively employed in analyzing PSSs which are complex systems including many stakeholders and objectives interrelated with each other through product life cycle. The proposed approach deals with the properties of PSSs through the general steps of system dynamics simulation procedure. It enables firms who adopt PSSs not only to evaluate and compare alternatives but also to describe and understand the systems' mechanisms and feedback links. A simple case of PSSs providing washing function is presented for illustration of the proposed approach.

Keywords: Product-service system, System dynamics, Evaluation, Customer satisfaction, Profitability, Sustainability

INTRODUCTION

Nowadays, manufacturers are suffering from lack of strategies for satisfying customers. Their agony is how to differentiate them in tough competitive market. One of the new arrival as a solution for this problem is product-service systems (PSSs) (Matthyssens and Buyl, 2005; Baines et al., 2007). By integrating products with services and various enablers, PSSs add value for customers. Moreover, PSSs are focused on in an ecological aspect. By emphasizing the 'sale of use' rather than the 'sale of product', PSSs enable manufacturers to reduce and optimize the use of resources. Increasing concern about environmental effect of economic activities is highlighting PSS as imperative milestone to achieve sustainability (Baines et al., 2007). Therefore, many manufacturers are trying to adopt PSSs for their benefits.

However, there are many barriers to adoption of PSSs. Lack of methods and tools for designing PSSs exists at the core of difficulty. PSSs have distinguishable features from products obviously. PSSs involve dynamics of system including many stakeholders and

objectives that are inter-related each other. That is, PSSs incorporate somewhat complex aims which are minimization of environmental impacts while maintaining enterprises' economical performance and service quality for users (Komoto et al., 2005). These facts lead the needs for new systematic methods and tools for PSSs. As it is already mentioned, systematic methods for designing PSSs have, however, not yet fully established. This implies that there is a lack of methods and tools for concept evaluation of PSSs. Concept evaluation to identify the most promising design concept has been considered very critical as it has significant impact on the downstream development processes as well as on the success of the PSS developed (Zhai et al., 2009). Thus it is much important to establish systemic PSS concept evaluation methodology at the systemic level in practice.

This paper aims to propose an approach to evaluating concept of PSSs by simulating alternatives using system dynamics. System dynamics is a method which was developed to support the dynamic behavior in complex system. It can be effectively employed to analyzing PSSs which are complex systems including many stakeholders and objectives interrelated each other through product life cycle.

Remained of this paper is organized as follows. The basic concept and related studies on PSSs and system dynamics are discussed each in the following sections. After the proposed approach for evaluating PSSs using system dynamics is introduced in the next section, a simple case is presented for the illustration of the proposed approach. Finally, summary and further discussion concludes this paper.

PRODUCT-SERVICE SYSTEM

Product-service system (PSS) is a marketable set of products and services capable of jointly fulfilling user's needs (Goedkoop et al., 1999). The PSS concept aims at minimization of environmental impact with use of alternative production and consumption patterns. There are several definitions for PSS, but it has been generally described as 'a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models (Mont, 2002)'. At its core, PSS focuses on the delivery of a 'function' to the customer, instead of sale, ownership, consumption, and disposal of 'products' (Williams, 2006). Actually the approach is to substitute services for products and moving from 'product thinking' to 'system thinking' (Mont, 2003).

Within a traditional paradigm, the relationship between a producer and a consumer is quite simple (Williams, 2006). When the producer sells a product after designing and manufacturing, the consumer buys it. This is the end of producer's roll because the producer has given ownership to the consumer. In contrast, in PSSs, manufacturers' involvement and responsibility is extended from making a product available to purchase to phases of the life cycle that are usually outside the buyer-seller relationship. Therefore PSSs require close integration of all actors within the life cycle of products (Mont, 2002; Mont, 2003). The stakeholders in PSSs interact actively each other forming network, thus the relationships among them are likely to be complex.

This complexity can make firms difficult to design PSSs. In some cases, it will result in an additional cost for communication and a slower market introduction because of the difficulty in explaining (Goedkoop et al., 1999). Although various tools and methodologies have been

introduced for designing PSS (Mont, 2000; Goedkoop et al., 1999; Aurich et al., 2006; MEPSS Handbook, 2004; etc.), still there is lack of critical and in-depth evaluation of their performance in practice and need for in-depth and rigorous research to develop models, methods, and theories (Baines et al., 2007).

Especially, as concept evaluation to identify the most promising design concept has been considered very critical on the success of the PSS (Zhai et al., 2009), many related studies have been conducted. In the first place, some researchers mentioned about what to evaluate. Maxwell and Vorst (2003) identified nine criteria for optimizing PSS: functionality, environmental impact, social impact, economic impact, quality, market demand, customer requirements, technical feasibility, legislation and technical industry specifications. While Thoben et al. (2001) focused on economic impact, market, and customer because they asserted that the goals of PSSs are proposing an attractive package for the customer and standing out from competition, Bhamra et al. (2001) attended to environmental impact and social impact from asserting that PSS involves environmental considerations such as dematerialization and sustainable products.

Looking over studies aiming to propose specific methods or tools, we can identify the two critical factors that most of them are focusing on. The one is economic value based on customer satisfaction and the other is ecological effect based on product life cycle. Caswell et al. (2008) developed a computation model to estimate economic value of service system that could be aligned with PSSs by definition. The model takes into account partners' satisfaction and the additional value which is created by the relationships among the various partners. Tasaki et al. (2006) suggested a quantitative method to evaluate the level of material use and waste generation in lease/reuse systems, using a simple indicator in terms of annual product demand. As a consequence, whether a system shortens or extends the lifetime of products appeared to be the key factor to determining material intensity, not whether the system itself was a lease system or a possession system. Komoto et al. (2005) proposed a methodology to analyze PSS based on discrete event simulation technique. They described the resulting performance of product life cycle as a function of occurrence of the PSS-events and their individual performance.

Although various attempts to deal with evaluation of PSS, there still exist some limitations or problems. Little systematic approach to evaluate PSS from multi-objective perspectives is established. Interrelations among the objectives are scarcely considered even though multi-objectives are estimated. Moreover, they tend to oversimplify the complex systems not fully considering the characteristics of PSSs.

SYSTEM DYNAMICS

System dynamics is a methodology that was specifically developed to support the study of dynamic behavior in complex system. It draws on a wide variety of disciplines to provide a common foundation for understanding and influencing how things change over time. Its central concept is that all the objects in a system interact through causal relationships. System dynamics recognizes the roles of the feedback information and the cause-and effect relationships in creating the dynamic behaviors of the systems, and takes an integrative perspective in modeling the system (Rabelo et al., 2005).

System dynamics modeling is mainly about discovering and representing the feedback

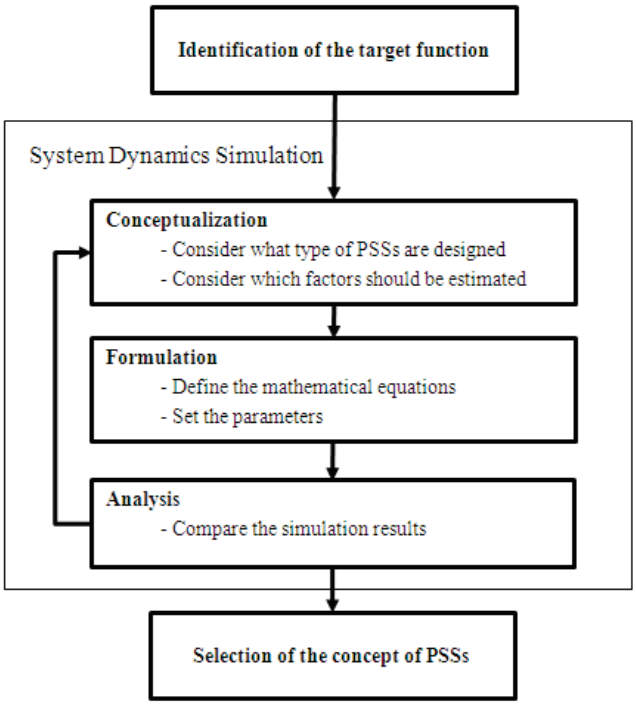
processes (Sterman, 2000; Hjorth and Bagheri, 2006). It determines the dynamics of a system along with stock and flow structures, time delays, and nonlinearities. As a result of these processes, causal loop diagram is drawn. Causal loop diagram is a powerful graphic tool to see the relationships among a system's parts and their interactions with each other. It is composed of a simple node-arrow construct that interlink key system variables by arrows indicating directions of causality. And a series of causal relationships consists of the set of interconnected feedback loops. While attempting to draw causal loop diagrams, we can enhance learning in complex system through not only a better understanding of a system's mechanisms and feedback links, but also modifying decision rules and mental models of the real world (Hjorth and Bagheri, 2006; Sterman, 2000). This has helped many managers to think how a strategy might or might not work, and what kind of consequences emerge. Finally, simulation models based on causal loop diagrams are built and run, which help to analyze system performance under different scenarios.

We found the possibility of system dynamics to be employed successfully in PSSs. As mentioned earlier, PSS is a large and complex system including many stakeholders and transactions. There are multiple driving forces such as customer satisfaction or sustainability, which have interdependence among each other. System dynamics approaches reasonable and actual solution by incorporating various interests and interactions of objects in complex system, and reflecting dynamic behavior. PSSs need long-term feedback during product life cycle. Although that is one of the main reasons many existing approaches cannot be employed to PSSs successfully, system dynamics can deal with this issue satisfactorily. System dynamics has been used in the business to evaluate the impact of business alternatives on the long-term performance of the enterprise (Rabelo et al., 2005). The fact that system dynamics is considered as a powerful methodology to deal with issues of sustainability (Hjorht and Bagheri, 2006) enhances the suitableness of system dynamics for PSSs.

In addition, designing PSSs is iterative process with restructuring business organization. Simulation technique deals with the repetitive tasks efficiently. As system dynamics does not depend on data and has been considered suitable for qualitative parameters in management decisions, it has more powerful in concept evaluation phase. Therefore, system dynamics enables the efficient and effective decision-making during the iteration of concept design process for PSS.

EVALUATING PRODUCT-SERVICE SYSTEMS

In this chapter, we briefly explain the procedure of evaluating PSSs to aid manufacturers to adopt PSSs. Following the general steps-conceptualization, formulation, and analysis-in system dynamics simulation process, we focus on the characteristics of PSSs. Figure 1 depicts the framework of proposed approach.



[Figure 1] Framework for evaluating PSSs concept using system dynamics

Based on the target function that would be offered to customers, manufacturers conceptualize their PSSs concepts. While manufacturers have delivered their offering to customers by selling their products traditionally, the offering is function in PSSs. The delivered form of function varies in integrating way of various service enablers. Generally, there are three types of PSS(Baines et al., 2007) as shown in Table 1. Depending on the PSS type, the stakeholders, their roles, and transactions in system are varied. Therefore, considering the delivering way of target function can be a good starting point for establishing variables to conceptualize PSSs.

[Table 1]Three types of PSS

Type	Description
Product-oriented PSS	promoting/selling the product in a traditional manner, while including in the original act of sale additional services such as after-sales service to guarantee functionality and durability of the product owned by the customer
Use-oriented PSS	selling the use or availability of a product that is not owned by the customer
Result-oriented PSS	selling a result or capability instead of a product

After deciding the delivering way for the target function, defined the estimated factors of the PSSs. As summarized in section 2, several critical factors for designing PSS were identified. Firms are able to consider some of them depending on their purposes. Generally, customer satisfaction and sustainability are considered as main objectives of PSS. And it is no wonder that economical benefit of firms is also included.

The important task in conceptualization step is lining the relationships among the established variables. The core of conceptualization of PSSs in system dynamics exists in finding how the critical factors are connected each other. The stakeholders make complex tangible and intangible transactions, and the critical factors are resulted in these transactions and additional variables. The variables and their relationships are represented in causal loop diagram.

The rough relationship depicted in conceptualization step is defined as mathematical form in formulation step. Many studies have proposed the calculation for each factor. Firms can apply or modify those proposed equations depending on their situation and purpose. Generally, customer satisfaction is calculated from perceived value and paid cost and profitability of firms is calculated from price and cost. In the case of sustainability, there exist various approaches to estimation. In practice, guidelines or regulations from committee or government approach are useful. And then, parameters for simulation are determined

Finally, the model is simulated. Results of each concept are analyzed and compared each other. If necessary, the simulation can be repeated based on several scenarios. As the dynamics of PSS range over product life cycle, change of environment should be fully considered. Additionally, finding uncovered feedback loop provides the opportunity for correcting their strategy and solving their problems. As a nutshell, the results of simulating PSS concepts imply some important insights that are hard to be provided from other approaches for firms. The application of this approach depends on the situation of firms in practice. In the next section, an example is presented for illustration of this approach.

ILLUSTRATIVE EXAMPLE

The proposed approach is applied to a washing machine manufacturer. The firm is faced the issue on whether it keeps the existing business model or not. Traditionally, the firm has sold washing machines to customers. The traditional business model seems that it cannot guarantee the growth of the firm any more. Therefore, new concept of business model as a PSS for providing washing function is proposed. In the new business model, washing function is provided to customers by guaranteeing accessibility to the washing machine owned and maintained by manufacturer. It is called ‘pay-per-use model’ and ‘use-oriented model’ in the classification of PSSs type.

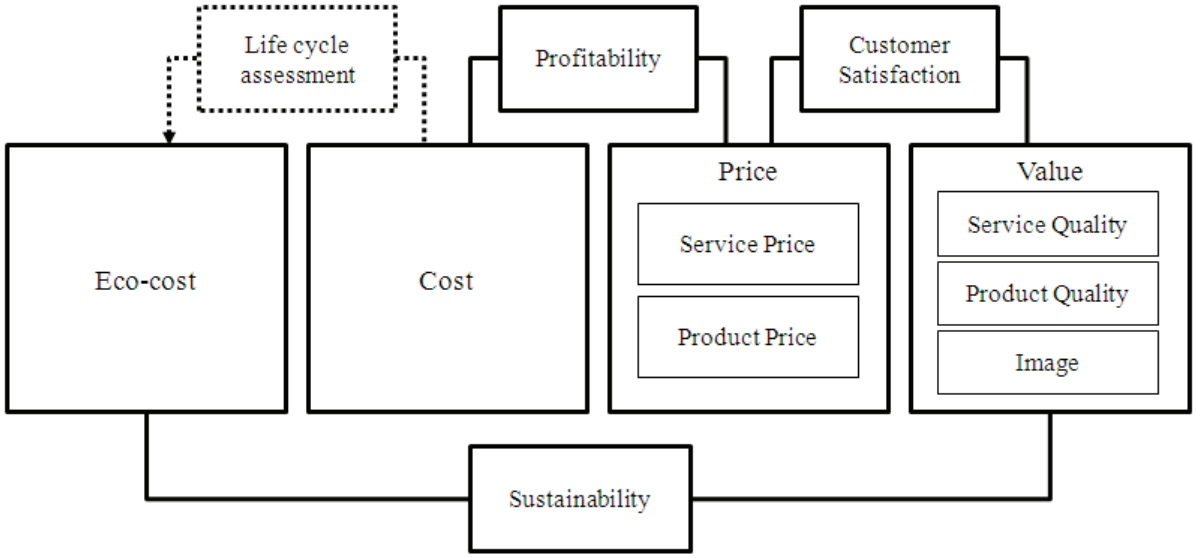
Roles and relevant stakeholders during product life cycle are depicted in table 2. Product model used in each concept is also different. While products in the traditional model are not reused, other products in the alternative would be reused by the manufacturer.

[Table 2] Example of role and responsible part for each concept

Concept		**Traditional model**	**Alternative**
Product model		Household	Community
Role	Manufacturer	Manufacturer	Manufacturer
	Owner	Customer	Manufacturer
	Operator	Customer	Customer
	Maintainer	Customer	Manufacturer

Disposer	Customer	Manufacturer
Reuser	-	Manufacturer

The firm is concerned about the profitability acquired from each PSS concept. Customer satisfaction and sustainability are also main factors to be estimated. Generally, customer satisfaction is considered as the basis of the profitability. In aspects of environment and pollution, government is tightening regulations. Moreover, eco-friendly firm gets more attractive to customers. Based on the physical transaction among the stakeholders, these key factors are estimated. After the variables comprehensively established, the relations among them are mapped. Figure 2, the strategic model for PSS, conceptually shows the relations among the variables.

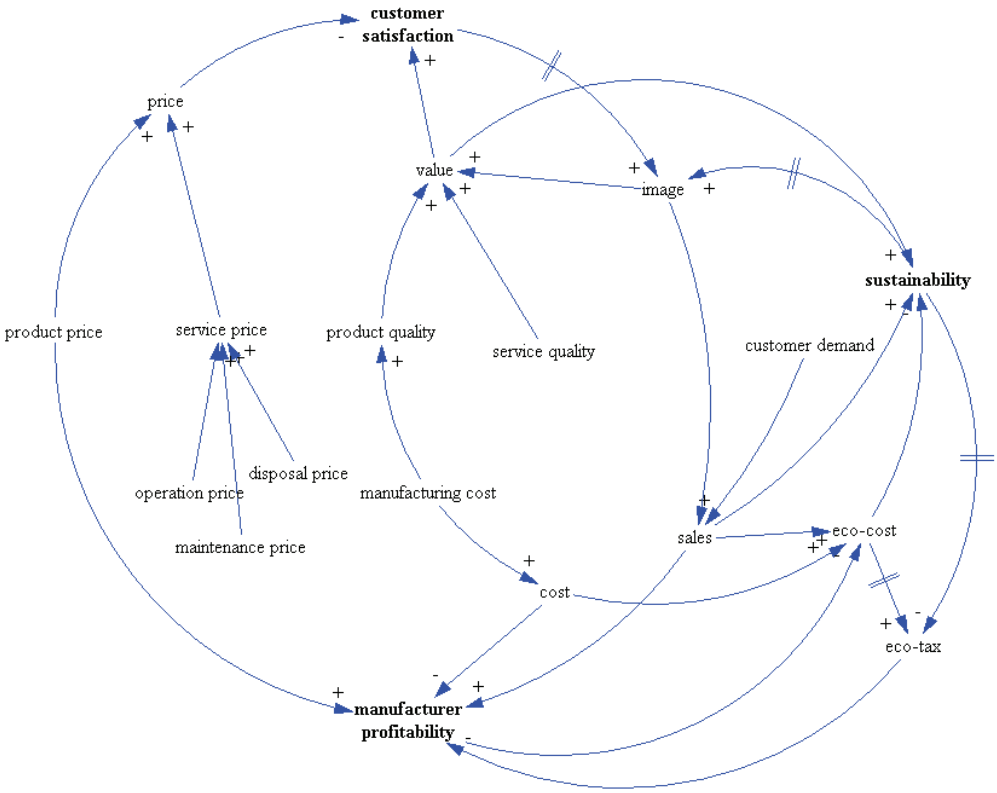


[Figure 2] Strategic model for PSS

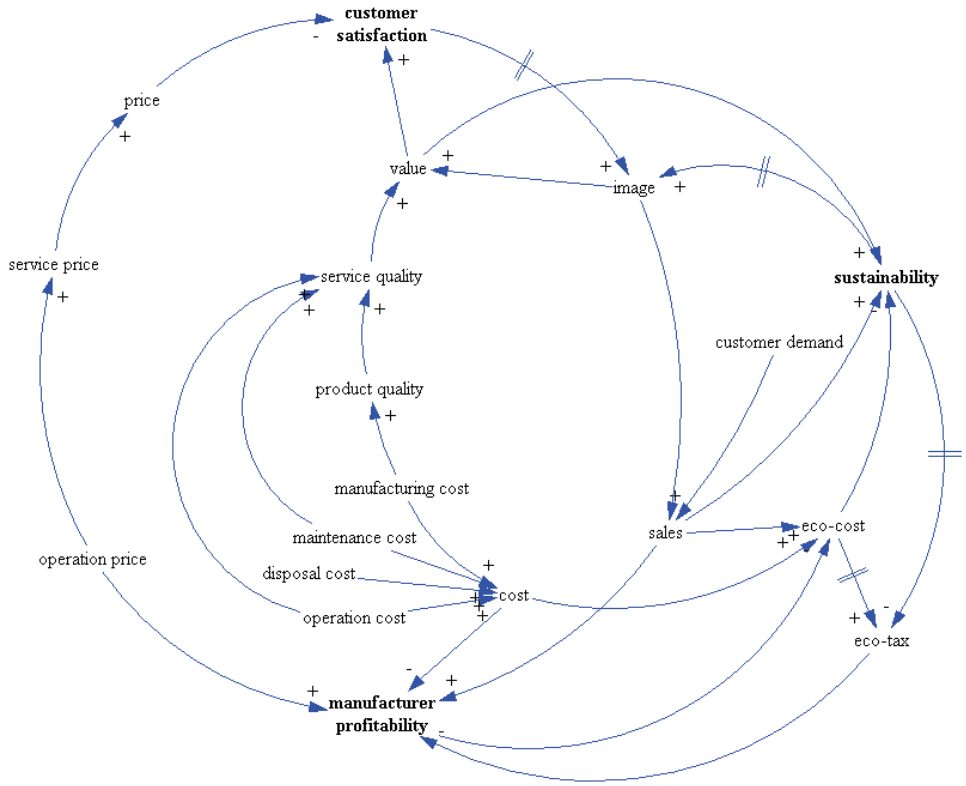
Figure 3 and figure 4 are causal loop diagrams based on the strategic model. While manufacturer get the product price in the traditional model, the operation fee is income of manufacturer in alternative. The service that has been traditionally provided by the third party is provided by manufacturer in alternative. Additionally, some different causal links are identified.

Completing the conceptualization of each model, the relation is formulated into mathematical equations and parameters are set for simulation. Customer's satisfaction is calculated with value divided by price. Manufacturer's profitability is basically calculated from the differences from price and cost. In practice, tax for environmental regulation is included in cost. In this simulation, however, the tax is subtracted from the price as a distinguished item for highlighting the relation between profitability and sustainability. To make this illustrative case to be simple, the equations related with environmental is supposed as very simple form. The tax is calculated based on the sustainability of the system. Sustainability in this simulation is estimated as eco-efficiency (Vogtländer et al., 2001). Eco-cost is proportional to cost. The simplification of mathematical equations in case study is not critical considering the

purpose of this case study and this paper. For each variable, the equation is specifically defined and parameter is set. The products' feature used for setting parameters is depicted in table 3.



[Figure 3] Causal loop diagram of traditional model

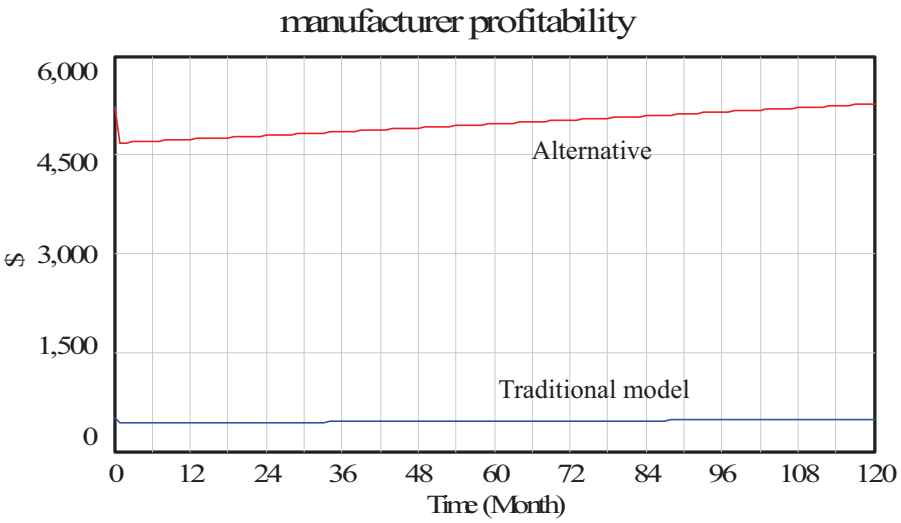


[Figure 4] Causal loop diagram of alternative 1

[Table 3] Feature of product for each model

	Traditional model	**Alternative**
Product type	Household	Community
Price [$]	500	1000
Life time [year]	10	5
Operation capacity [operation/week]	5	100
Capacity [kg/operation]	4	6
Failure rate [/operation]	0.0001	0.0001
Operation cost [$/operation]	0.2	0.3
Operation fee [$/operation]	0.2	0.3
Repair cost [$/failure]	100	100
Repair fee [$/failure]	100	150
Disposal cost [$]	25	25
Reusable	No	Yes
Reuse cost [$]	-	75

Results of the simulations show that level of customer satisfaction and sustainability in alternative are higher than those in traditional model. This leads the rapider increase in manufacturer profitability in alternative than the increase in traditional model shown in figure 5. That is, the performance of new business model is expected to be better than traditional model. Thus, the new PSS concept, ‘pay-per-use model’ is recommended to be adopted.



[Figure 5] Simulation result-manufacturer profitability

CONCULSION

This study proposes a simulation-based approach for evaluation of PSSs. PSSs are large and complex systems with multi-objectives that depend on each other. The proposed approach serves these distinguishable attributes of PSSs using system dynamics. The case of washing machine manufacturer was presented for illustration of the proposed approach. The illustrative case shows the possibility that proposed approach based on system dynamics can be successfully employed in modeling and analyzing PSSs. Analyzing more simulation results on customer satisfaction, sustainability, and other causal variables is listed as ongoing work. That would be more fruitful insights for manufacturers.

However, the refinement of proposed approach is still remained. Each step need to be more clarified and detailed. Further, more abundant and realistic case study is practically useful for lots of manufactures who try to adopt PSSs.

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THE STRUCTURAL IMPACT OF SUPPLY CHAIN MANAGEMENT ON PROCESS PERFORMANCE

Arawati Agus, Graduate School of Business, Universiti Kebangsaan Malaysia,
araa@pkrisc.cc.ukm.my
Za'faran Hassan
Faculty of Business Management, Universiti Teknologi MARA, Malaysia.
zafaran@salam.uitm.edu.my

ABSTRACT

Supply chain performance and effective management of supply chain have been increasingly recognized as critical factors in gaining competitive advantage. More and more firms are increasingly making use of SCM to improve their performance. This paper presents the findings of a research which examines the relationship between supply chain management (SCM) practices and process performance in manufacturing companies in Malaysia. The study measures senior management's perception of SCM practices and the level of process performance in the industry. Associations between SCM and process performance are analyzed through methods such as Pearson's correlations, cluster analysis and Structural Equation Modeling (SEM) using 250 respondents' data. The findings suggest that SCM practices have significant correlations with process performance (comprises of processes such as demand management process, customer relationship management process, customer service management process and order fulfillment process). Specifically, process performance has high correlations with SCM practices namely as 'strategic supplier partnership', 'customer relationship performance', 'information sharing', 'lean production' and 'postponement concept' and 'technology and innovation'. The SEM result also reveals that SCM practices exhibit direct impact on process performance. Findings of the study provide a demonstration of the importance of SCM practices in enhancing process performance in Malaysian manufacturing companies.

Keywords: Supply chain management, SCM practices, process performance, business performance, manufacturing companies, changes, Pearson's correlation, cluster analysis and structural equation modeling.

INTRODUCTION

Today's global marketplace offers tremendous opportunities in achieving strategic competitiveness through effective supply chain management (SCM). The environment in which firms operate, today, has changed drastically with the growth in collaboration between competitors as well as business partners, outsourcing and also integrated supply chain systems. As global competition increases, businesses should be more involved in how their suppliers and customers do business. To compete successfully in today challenging business environment manufacturing companies should be able to effectively integrating the internal functions within a company and effectively linking them with the external operations of suppliers and supply chain members. They need to focus on supply chain management practices that have impact on enhancing SCM activities such as where materials come from, how their suppliers' products are designed and assembled, how products are transported and stored and what consumers really

wants. The process of making and distributing products and services to customers is becoming the most effective and efficient way for businesses to stay successful and is central to the practice of supply chain management.

Empirically, the purpose of this study is to present an explicit result on the relationship between SCM and process performance where other researchers have perhaps known or describe them only implicitly. There are studies which suggest that SCM improves performance but, with a few exceptions, rarely support it with statistical evidence. This study is one of few attempts to estimate the effect of implementing SCM programs on process performance. It fills a gap that exists in the literature on SCM in the manufacturing industry in Malaysia.

Since the purpose of this paper is to enhance managerial understanding of supply chain management and process performance in relation to SCM implementations, the main objectives of this paper are:

(1) To empirically investigate relationship between supply chain management (SCM) practices and process performance.
(2) To empirically assess the structural effect of each SCM practice.

This paper explores the possibility of adopting SCM as the basis for enhancing process performance in manufacturing companies. First, this paper proceeds with an introduction, the objectives of the study and the test conducted to obtain the reliable measures of the variables; Secondly, it continue with a brief explanation on the SCM principles and literature review; Thirdly, it describes the conceptual framework consisting of the conceptual model and hypotheses; Fourthly, it discusses the methodology adopted; Fifth, it highlights the results of Pearson correlations, cluster analysis and structural equation modeling. Finally, the results are then discussed and implications highlighted.

SUPPLY CHAIN MANAGEMENT (LITERATURE REVIEW)

Supply chain management includes managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer. The term SCM was first used in the 1980s and as such is a relatively new discipline within management theory with tools and concepts still being developed. As with most management subject areas, many definitions have been used to explain the term SCM. The frequency with which the term “supply chain management” (SCM) is used in today’s environment would suggest that it is a well understood concept accompanied by an accepted set of managerial practices. However, definitions of and approaches to SCM vary substantially from organisation to organisation. Schonsleben (2004) defines SCM as coordination of strategic and long-term cooperation in logistics networks (Windischer and Grote, 2003). Tan, et. al. (1998) defines SCM as the simultaneous integration of customer requirements, internal requirements and upstream supplier performance. Quinn (1997) similarly views the supply chain as a set of processes. According to Quinn (1997), the supply chain includes all of those activities associated with moving goods from the raw-materials stage through to the end user. This includes sourcing and procurement,

production scheduling, order processing, inventory management, transportation, warehousing and customer service. It also embodies the information systems which are necessary to monitor all of those activities. Ellram and Cooper (1990) viewed SCM as an integrating philosophy to manage the total flow of a distribution channel from supplier to the ultimate customer. Christopher (1998) defines the supply chain as the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer. Supporters of this approach (e.g. Hakansson, 1982; Wijnstra, 1998) argue that buyer-seller relationships are influenced not only by the characteristics of the product and the organizations involved, but also by the relationships between these organisations and other organisations which are part of the supplier network. SCM coordinates and integrates all of the supply chain activities into a seamless process. SCM links all of the partners in the chain, including departments within an organisation and external companies and information systems providers. A key point in SCM is that the entire process must be viewed as one system (Lummus and Vokurka, 1999). This definition highlights the importance of managing boundaries between business partners. Robinson and Kalakota (2000) view the supply chain quite simply as a "process umbrella" under which products are developed and delivered to customers. From a structural viewpoint, they argue, the supply chain refers to the complex network of relationships that organizations maintain with trading partners to source, manufacture and deliver products. According to this view, an ideal supply chain consists of multiple companies that function as efficiently and effectively as a single company with full information visibility and accountability. The supply chain can be conceptualised in a number of different ways, ranging from network studies through production chains to behavioural analysis of dynamic inter-firm relationships (Hart and Saunders, 1997). Research shows that the development of effective supply chain coordination involves a multidimensional approach to systems integration, encompassing logistical flows, transfer of learning and trust-based relationships (Oliver et al., 1996; Hart and Saunders, 1997).

According to Ganeshan and Harrison (1999), a supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply Chain Management (SCM) is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 1998).SCM involves integration, co-ordination and collaboration across organizations and throughout the supply chain. SCM comprises determinants such as strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. All these determinants are considered as building blocks of SCM in today's business environment. SCM involves integration, coordination and collaboration across organisations and throughout the supply chain. Supply chain management requires coordination with customers and suppliers. Firms must achieve a relatively high degree of integration before implementing SCM. Supply chain management has the potential to assist the organisation in achieving both cost and a value advantage (Christopher, 1998). To gain competitive advantage, organisations have to adopt supply chain management (SCM) approach and consider the supply chain as a whole. Many researchers claim that supply chain management can result in better supply chain performance (Christopher, 1998 and Christiansee & Kumar, 2000). But very few

empirical studies have been carried to investigate the relationship between SCM and performance.

INDEPENDENT AND DEPENDENT CONSTRUCTS' MEASUREMENT: VALIDITY AND RELIABILITY

In this study, validity and reliability tests were used to select and assess the final items of the independent constructs that would be used for statistical testing. The SCM variables in this study were adopted from prominent studies or sources (Gunasekaran et al, 2003, Kuei et al., 2001, Li et. al, 2002, Hill, 2003, and Vickery, 1999). In this study, SCM was operationalized based upon six different kinds of activities that manufacturers commonly used to integrate their operations with suppliers and customers namely strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. As the initial data analysis, the six SCM variables were subjected to validity and reliability tests before a single score can be calculated to represent each construct. Multi item scales were developed for each construct in the study. Before creating the final scales, the data were checked for normality and outliers.

Table 1: Factor Analysis and Reliability Test

CONSTRUCT	Exploratory Factor Analysis –EFA (Varimax Rotation)			Confirmatory Factor Analysis – CFA		Reliability Test
	Eigenvalue	% of Variance Explained	Cummulative Variance Explained	GFI	CFI	Cronbach's Alpha
SCM	6.192	44.229	44.229	0.978	0.988	0.887
Process performance	4.203	30.022	74.251	0.918	0.971	0.965

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization (KMO= 0.957)

Exploratory factor analysis, confirmatory factor analysis and Cronbach's reliability analysis were used to select and assess the final items that would be used for hypothesis testing. The critical variables of SCM in this study had content validity because an extensive review of the literature was conducted in selecting the measurement items. The SCM determinants in this study were adopted from prominent studies or sources (Zairi, 1998; Murray, 1997; Mabert, 1992; Richman & Zachary, 1993). As the initial data analysis, the six determinants of SCM were subjected to validity and reliability tests. Exploratory factor analysis was conducted to investigate whether the constructs as described in the literature fits the factors derived from the factor analysis. The result from the factor analysis indicates that the KMO (Kaiser-Meyer-Olkin) measure is 0.957 with significant chi-square value (Barlett's Test of Sphericity = 3192, probability value = 0.000).

The value of KMO in this analysis surpasses the threshold value of 0.50 as recommended by Hair et. al (1998) and all the eigenvalues of the two constructs are above 1.00. All variables or determinants exhibit high factor loadings and almost fall into the designated factors as described by the literature. This result provides evidence to support the theoretical conceptualization of each construct. In addition, confirmatory factor analysis (CFA) or a measurement model using AMOS 5 was employed for examining construct validity of each scale by assessing how well the individual item measured the scale (Ahire et al., 1996). The goodness of fit indices (GFI) and comparative fit index (CFI) of the exogenous determinants exceeded the 0.90 criterion suggested by Hair et al. (1998), hence, establishing the construct validity (see Table 2).

Since data for this study was generated using scaled responses, it was deemed necessary to test for reliability. The reliability analysis was conducted by calculating the Cronbach's alpha for the main constructs. The result shows that the Cronbach's alpha measures for the main constructs exceeds the threshold point of 0.70 suggested by Nunnally (1978). Alpha coefficients for SCM and performance scales ranged between 0.887 and 0.965 after the alpha maximization processes were carried out (Table 1).

CONCEPTUAL FRAMEWORK

This paper explores the relationship between supply chain management and process performance within the context of the Malaysian manufacturing industry. The proposed model, as depicted in Figure 1, is based on two main constructs namely: (i) Supply Chain Management (SCM); and (ii) process performance (PROCESS).

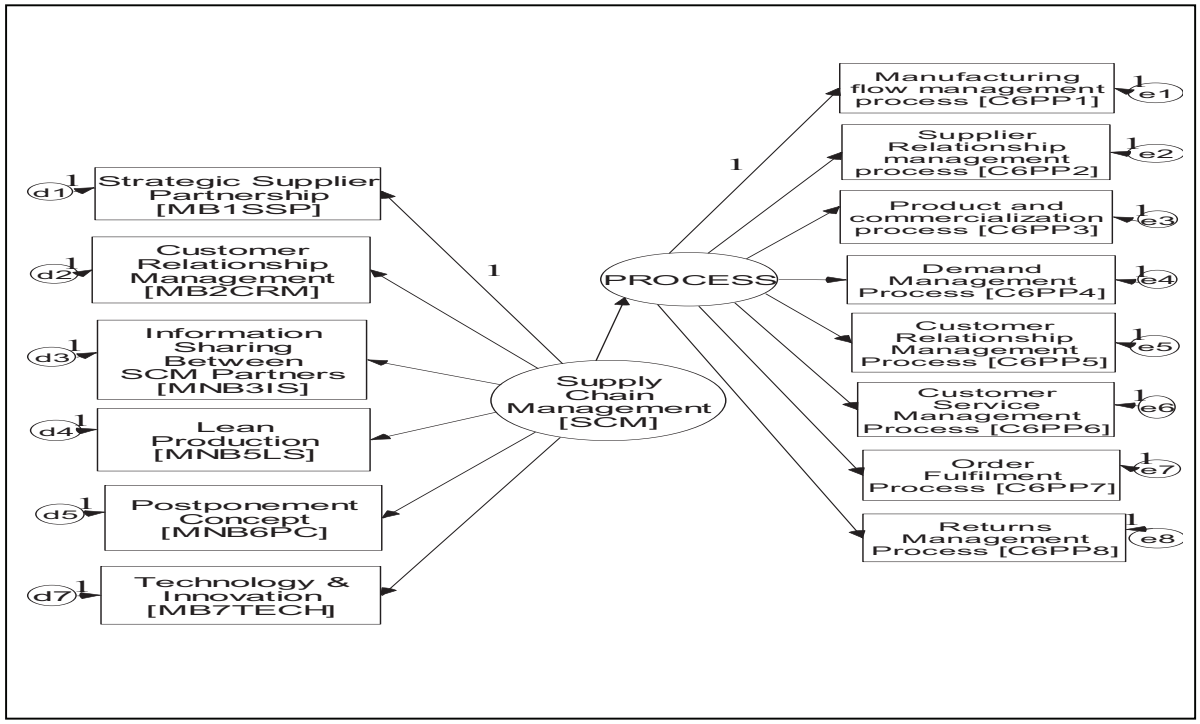

Figure 1: The conceptual model linking SCM and process performance

In this study, SCM represents a manager's assessment of the overall level of supply chain management practices (Davis & Heineke 2005, Mekong capital.com, 2004). In addition to improving levels of performance, SCM has also been shown to provide benefits in terms of outcomes (Inman, 1999, Arnheiter, & Maleyeff, 2005). The model proposed here uses SCM dimensions derived from studies and documented references. Six dimensions of SCM identified from several sources (Davis & Heineke 2005, Mekong capital.com, 2004) were considered to relate to distinctive features of SCM and are therefore incorporated in the present conceptual model. These SCM dimensions are strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation

In addition, several studies have identified performance improvement constructs that are commonly associated with SCM (Voss, 1988, *Gunasekaran et al, 2003, Kuei et al., 2001 and Cox, 1999*). Voss (1988) classified performance measures into three groups: market place competitive advantage, productivity increases, and non-productivity benefits. Specifically, this study focus on the impact of SCM on process performance which comprises dimensions namely manufacturing flow management process, supplier relationship management process, product and commercialization process, demand management process, customer relationship process, customer service management process, order fulfillment process and returns management process. Items included in the instrumentation for process performance, include such aspects relating to value chain cost, on-time delivery as well as inventory turnover.

Hypotheses

In investigating the influence of SCM practices on process performance, structural equation modeling is utilized to evaluate and analyze the magnitude and direction of the linkages between those constructs. The main hypothesis proposes that SCM has a positive structural effect on process performance. Conceptually, it suggests that with good implementation of SCM, process performance would be enhanced. Hence, in short, this study tests the following main hypotheses:

H_1: SCM has a positive structural effect on process performance (PROCESS).

In investigating the structural effect of SCM on overall results such as process performance, it is also pertinent to determine the structural loadings of each SCM determinant. Therefore, this study also attempts to test the following additional hypotheses:

H_{1A}: Strategic supplier partnership has a positive structural loading on SCM.
H_{1B} Customer relationship management has positive structural loading on SCM.
H_{1C}: Information sharing between SCM partners has a positive structural loading on SCM.
H_{1D}: Lean production has a positive structural loading on SCM.
H_{1E}: Postponement concept has a positive structural loading on SCM.
H_{1F}: Technology & innovation has a positive structural loading on SCM.

More importantly, this study aims to test the overall SEM model fit based on the main null hypothesis:

H_0 : The overall hypothesized model has a good fit.

For structural modeling, accepting this hypothesis indicates that the model presented adequately reproduce the observed covariance matrix (Bollen, 1989; Joreskog, 1989; Mueller, 1996) and suggesting that the data fit the proposed model.

RESEARCH METHODOLOGY

Sample companies were chosen from the manufacturing industry in Malaysia (the sampling frame was derived from the Federation of Malaysian Manufacturers Directory-FMM). Two hundred and fifty responses were received from a total of 300 sample companies chosen which representing 83 percent response rate. The primary purpose of the research is to gain insight into the benefits of implementing SCM in the manufacturing industry. The goal is to understand and determine measures of SCM that can enhance process performance. Face to face interviews with production or SCM managers were carried out to ensure the information accuracy, validating the outcome of analysis and developing an understanding of practical aspects of SCM principles adoption. To enable respondents to indicate their answers, seven–point interval scales were use for the questionnaire. Several items of SCM, which have been widely referred, were extracted. Similarly, the dependent variable namely process performance also used a seven-point interval scale, representing a range of agreement on statement whether over the past three years these process performance measures are high relative to competitors after implementing SCM practices.

FINDINGS

Correlation Analyses

As a preliminary analysis, Pearson's correlation analysis was conducted to establish associations between SCM practices and process performance. Table 2 exhibits correlation among the SCM variables and process performance measure. On the other hand, Table 3 highlights the descriptive and multicollinearity statistics. The result indicates that the SCM practices have significant correlations with one another and also with process management. In addition, it suggests that those SCM practices complement each other and need to be implemented in a holistic manner. Furthermore, the collinearity test does not indicate any multicollinerity problem. Process performance has high correlations with SCM practices especially with strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. These findings are consistent with several previous studies that proclaimed better organizational transformations as a result of SCM initiatives (*Womack et al., 1990; Womack and Jones, 1996, Lee, Peccei 2008, p4,* Inman, 1999, Arnheiter, & Maleyeff, 2005).

Table 2: Pearson's correlation among variables

SCM variables		1	2	3	4	5	Mean Process Performance
1	Strategic supplier partnership	1.00					.583(**)
2	Customer relationship management	.629(**)	1.00				.526(**)
3	Information sharing between SCM partners	.632(**)	.509(**)	1.00			.482(**)
4	Lean production	.619(**)	.573(**)	.548(**)	1.00		.617(**)
5	Postponement concept	.533(**)	.570(**)	.555(**)	.608(**)	1.00	.588(**)
6	Technology & innovation	.637(**)	.552(**)	.573(**)	.608(**)	.598(**)	.643(**)
	1. *P≤0.05, **P≤0.01 2. All t-tests are two-tailed						

Table 3: Descriptive and collinearity statistics

SCM		Mean	Std Dev	Collinearity Statistics	
				Tolerance	VIF
1	Strategic supplier partnership	5.1835	.9755	.407	2.456
2	Customer relationship management	5.5372	.9582	.506	1.978
3	Information sharing between SCM partners	4.6710	1.3753	.511	1.955
4	Lean production	5.2135	1.0887	.467	2.140
5	Postponement concept	5.3147	.9791	.492	2.032
6	Technology & innovation	4.9412	1.2641	.461	2.169

Notes: *p ≤ 0.05; **p ≤ 0.01 (all *t*-tests are one-tailed)

Cluster Analysis and Friedman's Rank Test

Since process performance is a very importance outcome in this study, therefore the cluster classification performed in this study is based on process performance clustering. This cluster analysis categorized these manufacturing companies into two groups:

(1) "High" process performance achievers
(2) "Average" process performance achievers

Table 4 highlights further information about the cluster groups. From the result, we can also infer that the higher level of SCM implementations are more realized in "High" process performance achievers than "Low" process performance achievers. "High" process performance achievers" put high priorities on lean production followed by technology & innovation, customer relationship management and postponement concept and. Investigating the background of these clusters, the result also indicates that the first cluster ("High" process performance achievers) comprises of large-scaled companies with average employees of more than 1,200 people and average approximated sales turnover of more than RM 1.5 billion. Mean while, the second cluster ("Low" process performance achievers) comprises of smaller companies with average employees less than 600 and average approximated sales turnover less than RM 80 million.

Table 4: Rankings of SCM practices based on process performance using Friedman's Test

SCM	"High" process performance achievers (n=151, chi-square = 81.135, significant=0.000, overall cluster's mean = 5.469)				"Average" process performance achievers (n=99, chi-square = 80.218, significant=0.000, overall cluster's mean = 4.486)			
	Friedman's Test	Rank	Mean	Std Dev	Friedman's Test	Rank	Mean	Std Dev
Strategic supplier partnership	2.82	5	5.0993	1.30450	3.62	4	4.6104	.80699
Customer relationship management	3.81	3	5.6309	.88895	4.56	1	4.9787	.93011
Information sharing between SCM partners	2.82	6	5.0993	1.30450	2.53	6	4.0177	1.21966
Lean production	4.11	1	5.7479	.82535	3.67	3	4.5767	1.06008
Postponement Concept	3.38	4	5.5057	.99679	3.86	2	4.6539	.81407
Technology & innovation	4.05	2	5.7343	.64036	2.76	5	4.0801	1.13977

Structural Equation Modeling

(i) The result of the preliminary model (Model A).

The study postulates that SCM has influence on product quality performance. Given the confirmatory nature of this study, the statistical analysis technique called Structural Equation Modelling (SEM) was utilized. A SEM model was employed to investigate simultaneous linkages that allow a researcher to determine the relative strength of relationships between variables. A two-step approach was employed. First, confirmatory factor analysis was performed to ensure that all the indicator variables used to measure the constructs were reliable and valid. Second, causal relationships between constructs were postulated and tested. The SEM model was evaluated to check if the specified items provided adequate fit. The relationship of SCM practices on process performance is depicted in the preliminary model as shown in Figure 2. In this statistical analysis, we would like the model developed to fit the data, therefore the acceptance of the null hypothesis of the overall model is expected. Hence, in this test of goodness of fit for the structural equation modeling, the probability we are looking for should be higher than 0.05.

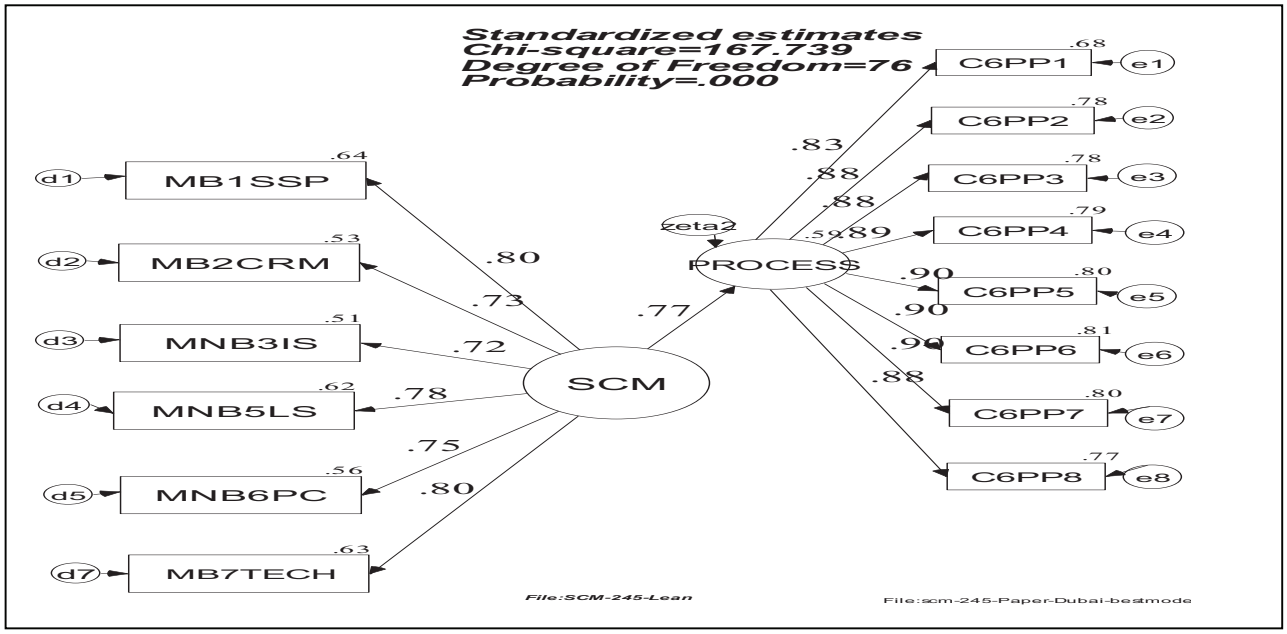

Figure 2: The result of the preliminary model (Model A) showing the structural linkage between SCM practices and process performance.

Unfortunately, the result of the preliminary model indicates that the χ^2 test and the probability value suggest a poor fit. The value of the Chi-square is equal to 167.74 with 76 degrees of freedom and the probability level of 0.000 (Table 5). On the whole, the result suggests that the proposed preliminary model has only a null fit and the data did not adequately fit the model. The unsatisfactory fit may relate to the high levels of random error and the many parameters that must be estimated (Bagozzi et. al 1991).

Table 5: The Measurement Result of the Preliminary Model

Statistics	Model Values	Recommended * values for good fit
Chi square	167.739	-
Probability Level	0.000	≥ 0.05
Degree of Freedom	76	-
χ^2 /df	2.209	≤ 3.00
Bollen (1989) Incremental Fit Index (IFI)	0.971	≥ 0.90
Tucker & Lewis (1973) TLI	0.965	≥ 0.90
Bentler (1988) comparative fit model (CFI)	0.971	≥ 0.90
Normed fit index (NFI)	0.949	≥ 0.90
Goodness of fit index (GFI)	0.912	≥ 0.90

*Chau (1997)

Even though the overall model has an unsatisfactory fit, the contributions of manifest variables in the model as well as the statistical significance of parameters' estimates of SCM and process performance are investigated. Standard errors and probability values are used to determine the precision of each parameter estimate. Parameters whose critical ratios are larger than 2.00 in magnitude are judged to be different from zero (Joreskog & Sorbom, 1989; Sharma, 1996, Mueller, 1996). The result indicates that the parameters have significant relationships and the variables are contributing to the concept. The loadings of the SCM variables (Figure 2) on the main latent construct suggest that strategic supplier partnership (0.798), technology and innovation (0.797), lean production (0.785) and postponement concept (0.750) are among the top variables with high contributions toward the SCM implementation. All SCM indicators exhibit significant critical ratios of above 2.00 (see Table 6). Therefore, we can suggest that strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation have positive and significant impact on SCM implementations.

Table 6: The Measurement Result of the preliminary model

(i)Constructs and indicators	Std. Loadings	Std. errors	Critical Ratio	Probability
a. Supply Chain management (SCM)				
Strategic supplier partnership	.798	.068	13.450	0.000
Customer relationship management	.731	.073	12.293	0.000
Information sharing between SCM partners	.717	.106	12.010	0.000
Lean production	.785	.082	13.450	0.000
Postponement concept	.750	.074	12.691	0.000
Technology & innovation	.797	.094	13.705	0.000
b. Process performance (PROCESS)				
Manufacturing flow management process [C6PP1]	.827	.133	11.734	0.000
Supplier relationship management process [C6PP2]	.883	.053	19.112	0.000
Product and commercialization management process [C6PP3]	.882	.054	11.734	0.000
Demand management process [C6PP4]	.888	.060	18.101	0.000
Customer relationship management process [C6PP5]	.896	.060	18.366	0.000
Customer service management process [C6PP6]	.897	.062	18.429	0.00
Order fulfillment process [C6PP7]	.987	.062	18.418	0.000
Returns management process [C6PP8]	.878	.063	17.739	0.000
(ii) Exogenous/endogenous Path				
a. SCM→ PROCESS [H_1 is supported]	.767	.079	11.254	0.000

Specifically, in order to ensure the success of SCM implementation, manufacturing companies need the support and commitment from SCM partners, adopt new technology and innovation in production process and SCM activities, eliminating waste wherever possible through lean production and be flexible in meeting changes needs and demand from customers using postponement concept. Surprisingly, information sharing between supply chain partners is not among top indicators of SCM in manufacturing industry in Malaysia. Probably the logical reason is because the culture of sharing vital SCM informations is not yet widespread in manufacturing companies in Malaysia. In addition, since customer relationship management (CRM) is still a new concept, this could explain why CRM has lower structural loadings on SCM implementations. By examining the structural loadings and their respective critical ratios and probability values, we can conclude two things. Firstly, we can say that strategic supplier partnership, technology and innovation, lean production and postponement concept have higher structural contributions toward SCM in manufacturing companies in Malaysia. Secondly, the

significant critical values indicate that SCM has positive effect on process performance. However, the overall result does not support the overall model fit, which is not uncommon when a measurement model has many items.

(ii) The improvement of the null model (Model B: The Parsimonious Model)

Since the overall result of the preliminary model (Model A) does not allow us to conclude that the suggested preliminary model has a good fit, the study will try to look at the element of standard structural validity for the modification of the overall model to improve its fit and to determine which of the exogenous and endogenous variables that are responsive and have direct causal relations with their latent construct (Joreskog and Sorbom, 1989). In addition, according to Tamini (1998), if the constructs were related to each other, they would all load on a higher order factor loading. Hence in this study, the model will be respecified by examining the exogenous measurements (SCM indicators) and investigating their contributions toward the main latent construct (SCM) and simultaneously the manifest variables of the endogenous construct will also be reexamined. According to Joreskog and Sorbom (1989), a structural loading (λ_{ij}^{s}) is a measure of the extent to which the variation of one indicator explains the variation of the latent variable. The indicator with the highest factor loading is the most valid indicator of its latent variable. High factor loadings are thus good indicators of the convergent validity of constructs. Closer examination of the parameters of the preliminary model (Figure 3) showed that the structural loading of customer relationship management (CRM) and information sharing between supply chain are not as high as the other four SCM variables (strategic supplier partnership, technology and innovation, lean production and postponement concept). This could be an indication that these variables have lower contributions and less responsive toward SCM implementations in manufacturing companies in Malaysia. Even though these variables exhibit significantly positive contributions toward SCM, however, they do not respond to the simple and direct relationship between SCM and process performance. This could mean that these SCM variables may be related to process performance in a more complex manner. As for the endogenous variables, only demand management process, customer relationship management process, customer service management process and order fulfillment process have high loadings and impact on the main latent construct. To improve the result, a second analysis on the respecified model is later performed to achieve a feasible and parsimonious model (Model B) with a more satisfactory fit.

(iii) The result of the final model (The parsimonious model)

The final parsimonious SEM model (Figure 3) exhibits the structural relationship of SCM on process performance after the modification process has been carried out. Note that in this model, two SCM variables namely customer relationship management and information sharing are dropped. Inversely, for the endogenous variables, demand management process, Customer relationship management process, demand management process, customer relationship management process, customer service management process, customer service management process and order fulfillment process high structural loadings and more responsive towards the impact on process performance, and therefore are retained in the revised model. The findings of Model B (the revised and parsimonious model) indicate that the resulting Chi-square value is

28.925 with 19 degrees of freedom and p-value of 0.067 (Figure 3 and Table 7). This supports the null hypothesis that the revised model has a good fit (H_0). The p-value is considerably substantial (p-value > 0.05), in supporting the proposition that the overall model fits the data. In addition, other statistical structural indices such as Bentler CFI (0.994), Bollen IFI (0.994) and Tucker and Lewis TLI (0.990) further suggest that the model has a satisfactory fit (Table 7). Since the probability value and structural modeling indices are well above the recommended level, the model is considered to be a reasonable representation of the data (Hair et al., 1995).

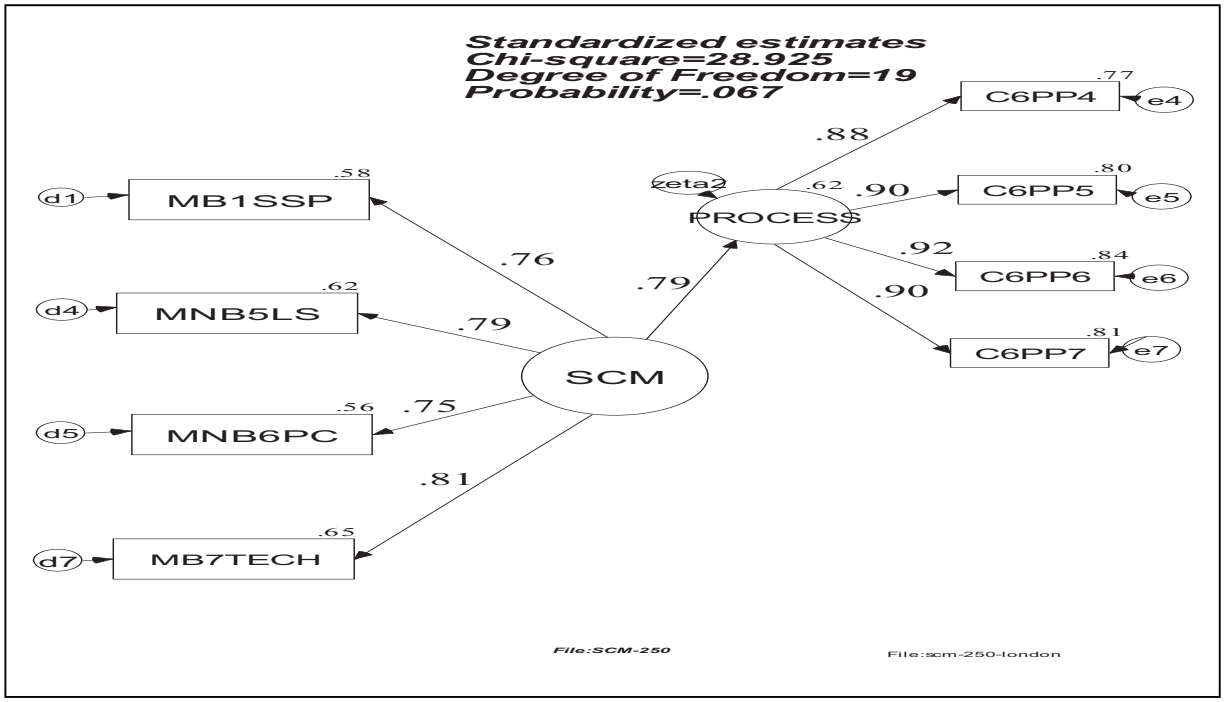

Figure 3: The final parsimonious SEM model showing the structural linkage between SCM practices and process performance (Model B).

Table 7: Measurement Results of the final SEM Model

Statistics	Model Values	Recommended * values for good fit
Chi square	28.925	-
Probability Level	0.067	≥ 0.05
Degree of Freedom	19	-
χ^2 /df	1.522	≤ 3.00
Bollen (1989) Incremental Fit Index (IFI)	0.994	≥ 0.90
Tucker & Lewis (1973) TLI	0.990	≥ 0.90
Bentler (1988) comparative fit model (CFI)	0.994	≥ 0.90
Normed fit index (NFI)	0.981	≥ 0.90
Goodness of fit index (GFI)	0.972	≥ 0.90

*Chau (1997)

The direct structural effect of SCM on process performance (PROCESS) is high (0.79) given the complex causal linkages, suggesting the significant importance of SCM practices especially strategic supplier partnership, technology and innovation, lean production and postponement concept in manufacturing industry in Malaysia (H_{1A}, $H_{1D,}$ H_{1E}, and H_{1F} are supported).. The standardized structural coefficient of SCM on process performance (0.79) is associated with low standard error (0.093) and non-zero critical value (11.295), which indicates that the structural effect between these two constructs, is positive and the relationship is significant (Table 8). Therefore, we have enough evidence to accept the proposition that SCM has a positive structural effect on process performance (H_1 is supported). In addition, we can obviously suggest that SCM practices can help manufacturing companies improve demand management process, customer relationship management process, customer service management process and order fulfillment process.

Table 8: Measurement results of the final SEM model

(i)Constructs and indicators	Std. Loadings	Std. errors	Critical Ratio	Probability
a. SCM (SCM)				
Strategic supplier partnership	.760	.070	12.334	0.000
Lean production	.788	.094	12.333	0.000
Postponement concept	.747	.085	11.655	0.000
Technology & innovation	.805	.109	12.613	0.000
b. Process performance (PROCESS)				
Demand management process [C6PP4]	.876	.048	20.376	0.000
Customer relationship management process [C6PP5]	.896	.041	22.772	0.000
Customer service management process [C6PP6]	.747	.047	22.771	0.000
Order fulfillment process [C6PP7]	.901	.048	21.786	0.000
(ii) Exogenous/endogenous Path				
a. SCM→ PROCESS [H_1 is supported]	.786	.093	11.295	0.000

Looking at the loadings of the SCM variables (Table 8) on the main construct, we can see that technology and innovation has the highest contribution towards SCM and it is followed by lean production, strategic supplier partnership and postponement concept. All of these indicators have significant probability values (critical values ≥ 2.00), giving statistical evidence that their contributions towards SCM construct are significant and positive. Therefore a manufacturing company can enhance its by integrating and implementing SCM strategies and practices.

CONCLUSION AND IMPLICATIONS

Many manufacturing companies have fought the global pressures of competition by becoming increasingly technologically advanced, moving up-market to more value-added products, and upgrading the skills of their domestic work force. SCM provides a vision that focuses everyone in an organization on better improvement. The pursuit of improvement is not only requested by the market but also driven by the need to survive. This paper tries to investigate the structural relationships between SCM and process performance in manufacturing companies in Malaysia. On the whole, we can suggest that SCM has a positive impact on process performance. Initially, the result of the preliminary model indicates that relationship between SCM and process performance only suggests a null fit. Viewing the result of the preliminary model on the relationship between SCM and process performance, the findings suggest a conclusion that there is no firm and direct link between some of the SCM variables and some of the process performance indicators. It should be noted that the model presented in this study reflects linear and direct linkages between SCM and process performance. It could well be that some of the variables of SCM and the indicators of process performance are related in a more complex way. Given that the results of this study show no empirical support for simple structural linkages, it is suggested that these constructs may be related in a more complex manner. However, further investigation on the contributions of each of the SCM variables and process performance indicators signals that some of the indicators are more responsive to the causal relationship between SCM and process performance, which suggests possible direct linkage between them. A revised model was analyzed which retained some of the more responsive manifest variables. The result of the revised and parsimonious model indicates a satisfactory fit.

SCM practices provide a vision that focuses everyone in an organization on SCM improvement. The pursuit of better improvement is not only requested by the market but also driven by the need to survive. This paper tries to investigate the structural relationship between SCM and process performance in the Malaysian manufacturing industry. The associations and effects of the SCM variables were evaluated using correlations, Friedman test and SEM. The results of the study assist in understandings on how SCM practices influence process performance. This study leads to several main conclusions. First, evidences suggested that:

(1) Technology and innovation, lean production, strategic supplier partnership and postponement concept have **positive** and **direct** effects on process performance.
(2) SCM practices have **positive** and **significant direct** effects on process performance specifically demand management process, customer relationship management process, customer service management process and order fulfillment process.

The conclusion emerging from this study is that SCM will ultimately results in positive gains. The results validate some of the key linkages and support beliefs and evidence by researchers of the relationship between SCM and process performance. It is also important to note that this study attempts to enrich the literature review and make a contribution in SCM-related studies. Obviously, its purpose has been to make explicit what other researchers have perhaps known implicitly with solid measurements. The empirical results support long-standing beliefs and anecdotal evidence by researchers about the relationships between the exogenous (SCM) and endogenous results (process performance), and lend credibility to causal hypotheses that

improving internal process leads to improvements in external performance results. This study to some extent helps in resolving controversy about the magnitude and measurements of performance gains from implementing SCM. By strengthening SCM practices, improved performance will likely to occur. This result provides evidence that improving internal practices will positively impact the most important performance measures.

This paper is relevant to practitioners because the findings may reveal important aspects in the implementation of SCM practices, which may provide significant information managers can use to solve implementation challenges and perhaps to improve performance. The paper would be of particular interest to practicing production managers or SCM managers as it suggest what factors should be emphasized to stimulate the adoption of SCM concepts in the Malaysian manufacturing industry. Moreover, the findings may provide support for continued implementation of SCM practices. The result indicates that manufacturing companies should emphasize greater attention to the technology and innovation adoption, waste reduction aspects through lean production and strategic partnership of the SCM practices and a greater degree of management support for SCM programs. Finally, the conclusion emerging from this study is that SCM will ultimately results in positive gains. The results validate some of the key linkages and support beliefs and evidence by researchers of the relationships between SCM and process performance. It is also important to note that this study attempts to enrich the literature review and make a contribution in SCM-related studies. In addition, its purpose has been to make explicit what other researchers have perhaps known implicitly. However rather than being conclusive, this study opens new avenue for future research.

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AUTHOR'S BACKGROUND

Arawati Agus is a Professor of Quality and Operations Management at Graduate School of Business, National University of Malaysia (UKM). She received a Bachelor degree in Finance from Southern Illinois University and Master in Management Sciences from St. Louis University. She obtained her Ph. D. in National University of Malaysia (UKM). Her area of research includes Quality Management, Supply Chain Management, Operation Management, Service Quality and Entrepreneurship. Her works have been published in Total Quality Management (UK), International Journal of Management, Singapore Management Review, International Journal of Production Economic, Security Industry Review (Singapore), Journal of Quality and Reliability, Malaysian Management Review and Management Journal (UKM).

Za'faran Hassan is an Associate Professor at the Faculty of Business and Management, Universiti Teknologi MARA. She obtained her BBA at Idaho State University, USA; MBA at Saint Louis University, Missouri, USA; and DBA at National University of Malaysia (UKM). She is an Associate Professor at Universiti Teknologi MARA, Malaysia. Her past administrative experience includes being the Dean of the Faculty of Hotel and Tourism Management, Director for Business Development, as well as Head of the Malaysian Entrepreneurship Development Center at her university. Currently, she is the Head of the Faculty of Business Management's Department of Management, Human Resource Management and International Business. She is an industry member for the Malaysian Productivity Corporation's Consultative Panel of Expertise for Tourism, Member of the Malaysian Institute of Management, and the Academy of International Business, as well as Associate Member of the Centre for Small Business & Regional Research (CSBRR), University of Wollonggong, NSW, Australia. She has presented papers at conferences and also published in various publications, both locally and internationallyShe is also a member of various local and international professional associations such as the Malaysian Institute of Management (MIM), Malaysian Society for Training and Development (MSTD), and the Academy of International Business (AIB). Her research interest includes areas related to Management, Strategic Management, SMEs, Entrepreneurship, Supply Chain Management and Quality Management.

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CUSTOMER SATISFACTION WITH INFORMATION TECHNOLOGY IMPLEMENTATION IN A GOVERNMENT AGENCY: A SURVEY ON ROYAL MALAYSIAN CUSTOMS

Najmi Mohd. Radzi, Royal Malaysian Customs, Malaysia
najmi@customs.gov.my
Dr. Abu Bakar Abdul Hamid, Universiti Teknologi Malaysia, Malaysia
m-abakar@utm.my
Dr. Chong Siong Choy, Putra International College, Malaysia
scchong@iputra.edu.my

ABSTRACT

This study is conducted to investigate the extent of customer satisfaction of the service delivery process through the implementation of information technology (IT) in the Royal Malaysian Customs (RMC), one of the prominent and technology-pioneering government agencies in Malaysia. Data were collected from two types of customers, i.e. internal (employees) and external (business clients), specifically from the RMC officers in the state of Selangor who use the Customs Information System (CIS) for the transhipment of goods (Customs Form 8-C8) and its business clients who comprise of forwarding agents, importers, and bonded warehouse licensees in the same state. The findings reveal that both types of customers are either indecisive and/or doubtful with the performance of CIS used by the RMC. It can be concluded that it is of paramount importance for the RMC, a government agency that provides service to the industrial population as its core business, to fulfil the satisfaction of both types of customers by provision of improving its service delivery process through the CIS used so as to ensure that the adoption of IT produces desirable outcomes.

Keywords: Information technology implementation, e-government, customer satisfaction, business clients, Royal Malaysian Customs, Malaysia

INTRODUCTION

Malaysia aspires to be a developed country comprising of a community that has an abundance of information and knowledge by the year 2020 in line with the National Vision Policy. With the awareness on the importance of technological knowledge as a catalyst for the development of the nation, the Malaysian government has conceptualized the Multimedia Super Corridor Malaysia (MSC Malaysia) project (for details, see Mohd Fairuz et al., 2008). In addition, the development of Putrajaya (the nation's administrative center within the MSC Malaysia) with state-of-the-art and sophisticated information and communications technology (ICT) and information technology (IT) infrastructure has completed the circle of IT development in Malaysia (Hizral, 1999).

Further, the government has provided a substantial sum of money for the delivery of electronic public services, more popularly known as Electronic Government (E-Government). E-government is referred to as the implementation of ICT to transform the structures and processes of government organizations aiming at performance improvement (Mofleh et al., 2009). It enables the simplification and automation of transactions between citizens and businesses, and even with different government entities (Metaxiotis and Psarras, 2005;

Sprecher, 2000) through multiple channels by using ICT, whose objective is to improve the efficiency, transparency, accountability, and effectiveness of the government (Gil-Garcia and Pardo, 2005; Gorla, 2008). By using ICT, the role of government changes from direct to a more limited involvement, thereby empowering citizens (Yu and Fang, 2005). As a facilitator of good governance (Rose, 2004; Sharma, 2004; Zhang, 2004), e-government thus has the ability to improve democratic, economic, and administrative governance (Gorla, 2008).

Gorla (2008) opines that e-government is becoming increasingly important due to the growth of ICT and Internet penetration. In Malaysia, for instance, the Malaysian Communications and Multimedia Commission reported that the penetration of Internet in 2007 is about half the size of the population (47.8% of 28,294,120 people) as opposed to 3,700,000 users in 2000 (http://www.mcmc.gov.my). This is due to the many initiatives undertaken by the Malaysian government in the development of ICT infrastructure and environment so as to enable the country to move rapidly into the Information Age as part of an important agenda of transforming the country into an information and knowledge-based society by 2020 (Tan et al., in press). Another reason is being the encouragement given to the development of ICT in the country as evident from the Seventh Malaysia Plan (1996-2000). This was the period that saw the inception of the MSC Malaysia (Chong, 2006). In fact investment of ICT in Malaysia has expanded at a rate of 9.2% per annum from RM3.8 billion in 1995 to RM5.9 billion in 2000 (Economic Planning Unit, 2001). About RM7.9 billion was invested on ICT programs under the Eighth Malaysia Plan (2001-2005) such as computerization of government agencies, schools, ICT funding, multimedia applications and developments, as well as ICT research and development. The following Ninth Malaysia Plan (2006-2010) witnesses an allocation of RM12.9 billion for the same programs (Economic Planning Unit, 2006).

Under the e-government initiative, a number of flagship projects have been developed and successfully implemented involving many areas such as smart school, telemedicine and the national smart identity card which involved a budget of RM1.06 billion. Several systems have also been created such as the Smart Transportation System which helps to eliminate traffic congestion in the Klang Valley area on top of imparting important information to traffic users. Other systems include the Project Validation Process, Human Resource Management System, E-Procurement, and the Generic Office Environment. Another measure that had taken place in is the launch of a program 'My-EG', in which a selection of public services is being made available online. From such developments, coupled with the development of broadband wireless Internet access, it can be seen that the Malaysian government is gearing up for change by putting into action a blueprint for the assimilation of IT into its governance structure.

It is therefore not surprising that the Royal Malaysian Customs (RMC), a government agency responsible for the collection of indirect tax and at the same time providing facilities to the commercial and industrial sectors, together with the task of safeguarding the national economy, social and security, is jumping on the IT bandwagon in its effort to prepare the agency towards the realization of Vision 2020. As a matter of fact, the RMC is among the first government agencies that adopted electronic data interchange (EDI) in 1994 as modified from the United Nations/Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT). As part of the e-government initiatives, the RMC introduced the Customs Information System (CIS) through the custom declaration forms in 1992 with manual key-in process designated for four types of forms, i.e. C1 (import), C2 (export), C8 (transshipment), and C9 (import-break bulk). In 1994, the RMC began using the EDI in

addition to CIS for its C1 and C2 forms. In 1997, the EDI and CIS were further augmented with the introduction of a single Electronic Fund Transfer (EFT) system, which was later upgraded to multiple EFT in 2003 which saw the application of EDI and CIS for C8 and C9. In January 2003, the use of EDI and CIS was enforced on the Paperless Export Normal C2 (for non-dutiable goods) form, which was extended to dutiable goods in July of the same year. In January 2004, the RMC introduced the Inter-station Centralization System (C8).

Notwithstanding its popularity, the applicability and practicability of e-government has been extensively debated (Ciborra, 2005; Davison et al., 2005; Holliday, 2002). Davison et al. (2005) for instance opine that it is reasonable to query whether governments really want to make the transition to e-government. This is attributed to the fact that the success of IT adoption in the public sector has not been very clear and/or consistent due to lack of research (Tang et al., 2009). Further, many e-government studies have focused on developed countries (Ke and Wee, 2004; Kolsaker, 2006; Lee et al., 2005) with very few research attempts being undertaken on developing countries. In addition, e-government is an evolving, multidisciplinary topic that involves various stakeholders with multiple value dimensions (i.e. financial, social, and political) (Chirchu, 2008; Yang and Paul, 2005). This led to the lack of clear understanding of managerial practices surrounding the role of central governments in the deployment and development of e-government (Mofleh et al., 2009). On the contrary, IT has been adapted by many multinational corporations (MNCs) and businesses with the key objective to tailor the available and emerging technologies to the specific requirements of those firms in order to increase efficiency and effectiveness of their delivery systems which ultimately help to realize their organizational goals. Matching both the elements is however a difficult task in the public sector which face different sets of priorities and therefore challenges compared to the business sector (Chirchu and Lee, 2005; Davison et al., 2005; Gil-Garcia and Pardo, 2005). This is evident from a study by Ghapanchi et al. (2008) who identified as many as 12 e-government implementation challenges. While the opponents failed to dissuade governments in the use of ICT, they have conveyed a clear message that governments will never be prepared for the change that is taking place if they are unable to link the role of governments as public service providers and the function of IT that is to assist the delivery of service to the citizens.

As such, as a government agency that provides service to the industrial population as its core business and consequently one of the major government revenue generating agencies, it is crucial for the RMC to continuously assess and improve its service delivery system due to the involvement of many of its stakeholders, specifically between the agency, its officers, and the business entities it serves. The relationship between the agency and its business entities is deemed an important determinant of e-government success, as business rather than individual Internet usage has been found to have greater exploratory value as an antecedent to the availability of e-government services (Boyer-Wright and Kottermann, 2008). It is therefore imperative to identify the satisfaction levels of RMC's officers and its business customers toward the use of the CIS. The resulting feedback will serve to inform the service providers on the level of effectiveness of RMC's CIS process, i.e. whether the current IT implementation is adequate, or a reengineering process is required.

It is against this backdrop that this study investigates the impact of RMC's IT implementation on the satisfaction of its officers and business customers. Specifically, feedback is gathered from the RMC officers who are responsible for the approval of dutiable goods movement within the bonded warehouse department and the declarations made by forwarding agents,

importers, and bonded warehouse licensees through the process of declaration and approval of Customs Form No. 8 (C8) using the CIS. Procedurally, the RMC's clearance for C8 is very important to ensure that its business customers receive their goods on time without any delay as this can affect their businesses. As such, it is important to observe the satisfaction of these external customers. In addition, the RMC management must ensure that every stage in the IT adoption has been properly undertaken so that the system will work smoothly. This can be observed from the satisfaction of its internal customers (officers). The implementation of CIS C8 is very important for many reasons, central to the assumption is that with IT implementation, it will facilitate the RMC in providing better services to its business customers. In short, the study is undertaken to provide answers to the following research questions:

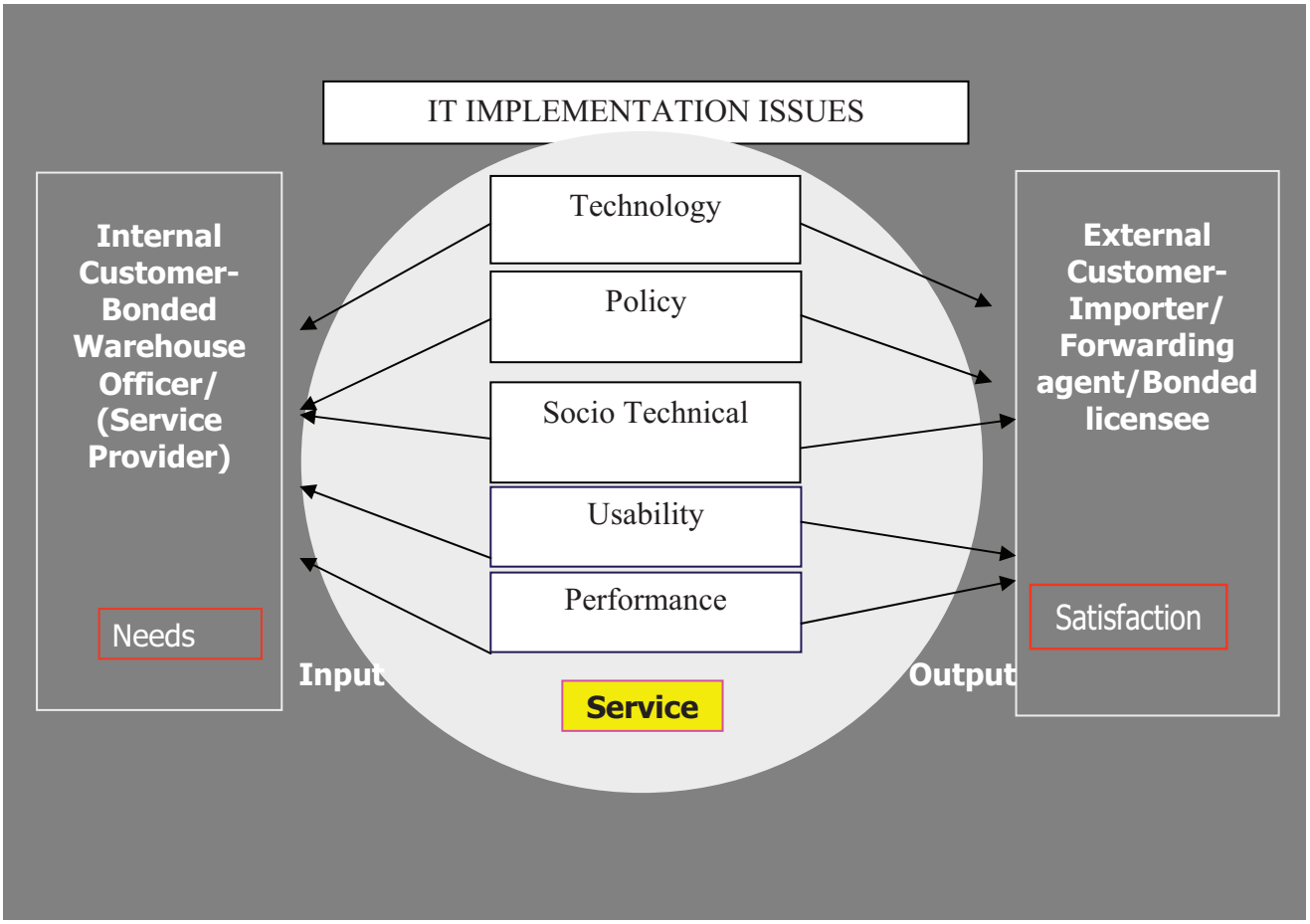
1) What is the level of IT utilization in terms of the CIS C8 declaration and approval process by the internal and external customers within the bonded warehouse department?;
2) What is the level of user satisfaction with regards to the CIS C8 process?; and
3) What are the areas that the bonded warehouse department should focus on to make sure that its IT implementation, specifically the CIS C8 process, is successful?

The rest of the paper is organized as follows. The next section presents the research framework employed in this study. The methodology used is detailed next, followed by presentation of the empirical results. The results are then discussed and implications provided before the paper is concluded.

RESEARCH FRAMEWORK

As Diagram 1 suggests, the RMC bonded warehouse officers provide service to their business customers in terms of granting approval to the transshipment of goods after their customers made declaration on the C8 form through the CIS. In providing the service through the use of CIS, the level of service quality is dependent on a number of factors such as technology, policy, socio-technical, usability, and performance on the part of the RMC as supported by the top management of the agency. At the same time, the same factors are also assumed to be important in fulfilling the needs and satisfaction of the business customers. On top of that, IT support infrastructure is also posited to contribute to the effectiveness of the service delivery. As such, the expected outcome is deemed to be the service realization through the use of the CIS process which will result in satisfaction to both the internal and external customers.

Diagram 1: Research Framework



RESEARCH METHODOLOGY

The research design is quantitative in nature, focusing on soliciting inputs and perceptions of the RMC bonded warehouse officers who are involved, and/or expected to be involved in any effort that will increase the performance and/or capabilities of their business customers, specifically on the C8 approval process through the use of CIS. These personnel comprise of all the RMC bonded warehouse officers from the lowest ranking to the most senior officers in the state of Selangor. This study focuses only on the state due to the fact that Selangor reported the highest revenue collection among all the states in Malaysia, with RM368.5 million collected in 2006 (representing 36% of all the revenues collected), out of which RM8.9 million is contributed by the bonded warehouse department. In terms of the total number of C8 clearance forms processed, the RMC's Annual Report (2005) indicates that Selangor ranked second after the state of Penang with 133,877 forms processed in 2005. Due to the small number of population, getting the involvement of as many RMC bonded warehouse officers as possible in the state is vital. There are currently 10 senior officers and 36 officers working in the department. About 34 officers agreed to take part in the survey.

The external customer is defined as those who are at the receiving end of the service which consists of managers and officers who manned the operations, purchasing, warehouse planning, and marketing departments of the forwarding agents, importers, and bonded warehouse licensees. As of 2007, there are approximately 1250 registered forwarding agents and 95 bonded warehouses in the state of Selangor. In practice, it is not uncommon to find that bonded warehouses seldom change forwarding agents. Moreover, it is not unusual for some established agents to handle a few bonded warehouses at the same time. This feature allowed the research to focus on respondents who are regular and familiar with the C8 declaration process using the CIS. About 35 business clients from 6 bonded warehouses took part in the survey.

Two sets of self-reporting questionnaires were developed and disseminated to both sets of the population. The questionnaires consist of two major sections. Section 1 is meant to solicit the respondents' demographic and psychographic information. Among the questions asked include age, highest education level, the availability of Internet connection, experience with Internet usage, and familiarity with the C8 process and CIS. Section 2 comprises of a series of items gauging the respondents' satisfaction levels on the various CIS implementation issues. About 51 items divided into 7 variables are administered to the RMC officers (refer Table 2), while the forwarding agents, importers, and bonded warehouse licensees were asked 31 questions from 5 variables (refer Table 3). All the questions in this section utilize a 5-point Likert scale, ranging from 1=highly dissatisfied to 5=highly satisfied with 3 scaled as neutral. Descriptive statistics, namely mean and standard deviation scores are used to interpret the data. Table 1 shows the interpretation of the mean scores obtained.

Table 1: Interpretation of the Mean Scores

Mean	Interpretation
1.00 – 1.49	Customer do not have anything that he/she is satisfied with
1.50 – 2.49	Customers' satisfaction at the lowest level
2.50 – 3.49	Indecisive , doubtful (customer doesn't give full attention)
3.50 – 4.49	Customers' satisfaction at a very high level
4.50 – 5.00	Customers' satisfaction exceeding beyond expectation

RESULTS

Demographic Profile of the RMC Officers

All the RMC officers are above the age of 26, with a majority of them possess minimum education qualifications (the Malaysian Certificate of Education or equivalent to GCE 'O' Levels). Many of the respondents have been in service for more than 15 years which explain the age and education level of the officers. About 41% of the officers own laptops, with 67% of them having Internet connectivity and 53% of them have experienced in using the Internet. However, it is interesting to note that the majority of respondents reported that they do not have Internet connection at the office (65%), and they therefore cannot access to the RMC's CIS at their workplace. The majority of the officers are familiar with the C8 process (64.7%) and the CIS (56%).

Level of Perceived Satisfaction of RMC Officers

Table 2 shows the results of descriptive statistics with regards to the satisfaction level of the RMC officers on the various CIS implementation issues. On an overall, the present IT environment scores the highest mean (3.34), followed by the contribution of IT through the satisfaction level of the overall CIS (3.30), the effect of technology and systems on effectiveness (3.21), level of IT usage in organization (3.17), IT in relation to management (3.02), socio-technical (2.99) and IT facilities (2.98). Based on the interpretation provided in Table 1, the mean scores of between 2.98 and 3.34 imply that the officers are indecisive and/or doubtful with the various issues asked upon them.

Similarly, the mean scores for each of the individual items suggest that the responses are within the range of neutral, judging from the mean scores of between 2.62 and 3.59. Only two items, i.e. "IT exposes me to become more creative" and "easy to analyze data" scored above or equal to 3.50. Satisfaction with the browsing speed scored the lowest mean. The responses to these questions corroborate the rates of satisfaction and/or dissatisfaction shown by the officers. About 62% of the officers are satisfied or highly satisfied with the exposure of IT that makes them more creative, while 56% of them are satisfied with the ease of data analysis. About 44% of them are dissatisfied of the browsing speed while 35% of them remained neutral on this item. The standard deviation scores for most of them items are below 1, indicating consistency in the respondents' answers.

Table 2: Descriptive Statistics of Perceived Satisfaction among the Internal Customers

	Descriptive Statistics	No	Mean	Std. Deviation	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Missing	Total
					Percentage						
Present IT	Faster information	34	3.206	1.067	5.88	20.6	29.4	35.3	8.82		100
	Effective info delivery	34	3.382	0.888	2.94	11.8	35.3	44.1	5.88		100
	Easy to analyze data	34	3.500	0.707		8.82	35.3	52.9	2.94		100
	Friendly IT environment	34	3.147	0.892		29.4	29.4	38.2	2.94		100
	Easy to communicate among staff	34	3.471	0.825		14.7	29.4	50	5.88		100
IT Facilities	Computer at workplace	34	3.000	0.985	2.94	32.4	32.4	26.5	5.88		100
	Software at workplace	34	3.059	1.013	2.94	32.4	26.5	32.4	5.88		100
	Technical support at workplace	34	3.000	0.921		38.2	26.5	32.4	2.94		100
	IT system at workplace	34	2.912	1.083	8.82	32.4	20.6	35.3	2.94		100
	Version of software used	34	2.912	0.996	5.88	32.4	29.4	29.4	2.94		100
	Reliability of equipment and peripheral	34	2.971	1.058	8.82	26.5	26.5	35.3	2.94		100
IT in relation to organizational Mgmt	Importance of IT training from dep't perspective	33	3.030	1.185	11.8	20.6	26.5	29.4	8.82	2.95	100
	IT awareness among mgmt	34	3.059	1.043	8.82	17.6	38.2	29.4	5.88		100
	Organizational image towards IT	34	3.235	0.955	5.88	11.8	41.2	35.3	5.88		100
	Department has effective guidelines	34	3.088	0.900		32.4	29.4	35.3	2.94		100
	Department allocates resources equitable	34	2.706	0.970	11.8	29.4	35.3	23.5			100
IT in relation to social technical interface	Regular hands-on workshop	33	2.788	1.053	11.8	26.5	32.4	23.5	2.94	2.95	100
	Frequent upgrade of PC	34	2.824	1.058	11.8	29.4	23.5	35.3			100
	Sufficient data communication	34	3.000	0.953	8.82	17.6	38.2	35.3			100
	Appropriate computer resources	34	3.147	0.989	5.88	17.6	38.2	32.4	5.88		100
	Appropriate software	34	3.235	0.987	5.88	11.8	44.1	29.4	8.82		100
	Good documentation	34	3.206	0.978	8.82	5.88	47.1	32.4	5.88		100
	Sufficient training	34	2.824	0.999	11.8	23.5	35.3	29.4			100
	Sufficient consulting	34	2.765	0.955	11.8	23.5	41.2	23.5			100
	Sufficient supporting staff	33	2.970	0.918	5.88	20.6	44.1	23.5	2.94	2.95	100
	Effective supporting staff	34	3.176	0.834		20.6	47.1	26.5	5.88		100
usage in organization	Have high level of IT knowledge	34	3.088	0.621		14.7	61.8	23.5			100
	Expert acquiring information through IT	34	3.029	0.627		17.6	61.8	20.6			100

	Doesn't required assistance	34	2.794	0.729	2.94	29.4	52.9	14.7			100
	Doesn't take time while retrieving data	34	3.059	0.776		26.5	41.2	32.4			100
	Complete understanding of IT usage	34	3.176	0.797	2.94	11.8	52.9	29.4	2.94		100
	Satisfied in using existing IT	34	3.118	1.008	2.94	32.4	17.6	44.1	2.94		100
	Can finish job faster	34	3.412	1.104	2.94	20.6	26.5	32.4	17.6		100
	Lots of my work involve IT utilization	34	3.235	0.890	2.94	14.7	44.1	32.4	5.88		100
	Existing IT gives me satisfaction	34	3.176	0.999	2.94	26.5	26.5	38.2	5.88		100
	IT exposes me to become more creative	34	3.588	0.821		11.8	26.5	52.9	8.82		100
Technology and Systems that affect the effectiveness	Screen layout design is appropriate	34	3.324	0.806		14.7	44.1	35.3	5.88		100
	Config of color & background clear/harmonious	34	3.382	0.739		11.8	41.2	44.1	2.94		100
	Screen guidance is clear and easy	33	3.333	0.736		11.8	44.1	38.2	2.94	2.95	100
	Easy access to information	34	3.471	0.896	2.94	8.82	35.3	44.1	8.82		100
	Information credibility	34	3.500	0.788		11.8	32.4	50	5.88		100
	IT infrastructure is reliable and safe	34	3.353	0.812		17.6	32.4	47.1	2.94		100
	No problem during navigating	34	3.059	0.886	2.94	23.5	41.2	29.4	2.94		100
	Rarely get disconnected	34	2.882	0.977	8.82	23.5	41.2	23.5	2.94		100
	Satisfactory browsing speed	34	2.618	1.074	17.6	26.5	35.3	17.6	2.94		100
IT contribution	Scope of work increases by computing	34	3.647	0.646			44.1	47.1	8.82		100
	Able to discuss needs	34	3.441	0.824		11.8	41.2	38.2	8.82		100
	Satisfied with application	34	3.088	0.900		29.4	38.2	26.5	5.88		100
	Satisfied with response time	34	3.000	1.101	11.8	17.6	35.3	29.4	5.88		100
	Satisfied with access to data	34	3.294	0.871		23.5	26.5	47.1	2.94		100
	Satisfied with data sets	34	3.324	0.976		26.5	23.5	41.2	8.82		100

Demographic Profile of Business Customers

The majority or 57% of the respondents are holding non-executive positions in their organizations, with 60% of them come from forwarding companies. Many of them range from 36 to 45 years old with the majority of them come from the Malay ethnic background (80%) and having the Malaysian Certificate of Education as their highest education qualification (70%). About 80% of them do not own laptops and 69% of them have no Internet connection at home. However, 74% of them connect to the Internet at their respective offices. The majority or 57% of the clients report that they have experienced in using the Internet. Almost all the respondents claim that they are familiar with the C8 process (91.4%), with 51% of them familiar with the CIS C8 interface. About 77% of the respondents reported that they declare the C8 at the terminal stationed at the RMC's office, while 14% of them perform the declaration at the EDI-enabled facilities outside the RMC's office.

Level of Perceived Satisfaction of Business Customers

Table 3 shows the results of descriptive statistics with regards to the satisfaction level of the forwarding agents, importers, and bonded warehouse licensees on the various CIS implementation issues. Among the variables, the contribution of IT in terms of the satisfaction level of the overall CIS scores the highest mean (3.42), followed by IT facilities (3.38), and the present IT environment (3.37). The variables of the effect of technology and systems on effectiveness and IT in relation to socio-technical interface score the lowest mean of 3.25 each. Again, the RMC customers are rather indecisive and/or doubtful with their responses, judging from the mean scores of between 3.25 and 3.42. However, compared with the mean scores obtained from the RMC officers, its customers seem to record higher satisfaction.

In terms of the individual items, the mean score is within the range of neutral for most of the items, looking at the mean score of between 3.00 and 3.70. Only four items were found to

score above or equal to 3.50. They are "scope of works increases by computing", "able to discuss needs", "effective information delivery", and "sufficient data communication". The satisfaction with browsing speed remains the lowest scored item (mean=3.00). To some extent, some support is found for the rates of satisfaction or dissatisfaction shown by the respondents although many of them rated the items within the range of neutral. The standard deviation scores for most of them items are below 1, indicating consistency in the respondents' answers.

Table 3: Descriptive Statistics of Perceived Satisfaction among the External Customers

	Descriptive Statistics	No	Mean	Std. Deviation	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Missing	Total
					Percentage						
Present IT	Faster information	35	3.3	0.98	5.7	14	34	40	5.7		100
	Effective information delivery	35	3.5	0.82	2.9	5.7	31	54	5.7		100
	Easy to analyze data	35	3.4	1.09	5.7	14	29	37	14		100
	Friendly IT environment	35	3.3	1.15	8.6	14	34	29	14		100
IT Facilities	Computer at workplace	35	3.3	1.12	5.7	17	40	20	17		100
	Software at workplace	34	3.4	0.98	2.9	17	29	40	8.6	2.96	100
	Technical support at workplace	35	3.4	0.95	2.9	11	37	37	11		100
	IT system at workplace	35	3.4	0.88	2.9	11	34	46	5.7		100
	Version of software used	35	3.4	0.91	2.9	11	40	37	8.6		100
	Reliability of equipment & peripheral	35	3.4	0.88	2.9	8.6	46	34	8.6		100
IT in relation to socio-technical interface	Regular hands-on workshop	35	3.1	1.06	5.7	26	34	26	8.6		100
	Frequent upgrade of PC	35	3.1	1.02	5.7	23	31	34	5.7		100
	Sufficient data communication	35	3.5	0.95		17	34	34	14		100
	Appropriate computer resources	35	3.4	0.88	2.9	11	34	46	5.7		100
	Appropriate software	34	3.4	0.93	2.9	11	31	43	8.6	2.96	100
	Good documentation	35	3.4	1.04	5.7	11	29	43	11		100
	Sufficient training	35	3.1	0.98	5.7	20	40	29	5.7		100
	Sufficient consulting	35	3.1	0.91	2.9	20	43	29	5.7		100
	Sufficient supporting staff	35	3.2	0.92	5.7	17	34	40	2.9		100
	Effective supporting staff	35	3.2	0.95	2.9	11	43	34	8.6		100
Technology and Systems that affect the effectiveness	Screen layout & design appropriate	35	3.3	0.91		2.9	57	34	5.7		100
	Config of color &background clear/harmonious	35	3.4	0.65		2.9	57	34	5.7		100
	Screen guidance is clear and easy	35	3.4	0.88	2.9	11	37	43	5.7		100
	Easy access to info	35	3.3	0.98	8.6	5.7	43	37	5.7		100
	Information credibility	35	3.4	0.94	5.7	8.6	34	46	5.7		100
	IT infrastructure is reliable and safe	35	3.3	0.87	2.9	8.6	49	31	8.6		100
	No problem during navigating	35	3.1	0.96	5.7	17	43	29	5.7		100
	Rarely gets disconnected	35	3.1	0.91	5.7	17	46	29	2.9		100
	Satisfactory browsing speed	35	3	0.95	5.7	23	37	31	2.9		100
IT contribution to organization	Scope of work increases by computing	34	3.7	0.94		11	26	40	20	2.96	100
	Able to discuss needs	35	3.6	0.74		2.9	46	40	11		100
	Satisfied with application	35	3.4	0.88		17	37	37	8.6		100
	Satisfied with response time	35	3.1	0.93	2.9	23	40	29	5.7		100
	Satisfied with access to data	35	3.3	0.85		20	40	34	5.7		100
	Satisfied with data sets	35	3.4	0.81		11	49	31	8.6		100

DISCUSSION AND IMPLICATIONS

In terms of the demographic and psychographic profiles of the respondents, the findings imply that despite age and education level, the majority of both the types of respondents have experienced Internet usage and are familiar with the C8 process and the CIS. This is probably due to the training provided by the RMC to its officers and customers. However, both groups indicate that the training they received is insufficient, looking at the mean scores obtained for the items measuring sufficiency of training and hands-on knowledge. Among the main areas that warrant attention from the policy makers in this section include the rate of the RMC officers who are unable to access to the Internet and thus the C8 CIS at their workplace. It is also contrary to expectation when the business customers report that they are more familiar with the C8 process than the RMC officers. The level of understanding of the RMC officers and customers toward the C8 CIS is also questionable, judging from the fact that only a simple majority of them understand the CIS.

As far as the mean scores are concerned, the study has successfully achieved its objectives by providing answers to the three research questions. It is obvious that the level of IT utilization among the RMC officers and its customers, particularly through the use of C8 CIS is still low. This is attributed to the lack of an environment and facilities conducive for IT implementation, top management support, and socio-technical conditions. All these have somehow created doubts among the officers on the effectiveness of the CIS utilized which have prevented the officers from using the CIS to a level of their satisfaction. Nevertheless, the majority of the clients who use the CIS at the terminals stationed at the RMC's office claim higher satisfaction levels to the items surveyed, albeit still within the range of neutral. This leads to the answer for the second research question in which both the RMC officers and the customers surveyed are rather indecisive and/or doubtful with the CIS, again with the customers reporting higher satisfaction level compared to the RMC officers. The answers to the first and second research questions have implications on the third question, i.e. what are the areas that the bonded warehouse department should focus on to make sure that the implementation of its CIS C8 is successful.

On an overall, the study lends support to the debates on the applicability and practicability of e-government, specifically on the challenges it inherit from the process of its implementation. This implies a gap between the deliverables conceived and the actual realization of such e-government initiative (Sushil, 2008). It is evident that the implementation of e-government at the RMC is still in its infancy stage, in view that the agency is still struggling with the various hurdles concerning e-government implementation such as personnel, technical, and environmental conditions. These issues are not considered new but are in fact recognized as challenges facing governments in the early stage of e-government initiatives. The results show that the facilities and environment are not friendly enough to spur greater usage of the CIS among the officers. They are facing technical and socio-technical problems such as lack of relevant technical skills due to lack of top management support, training, and shortages of skilled personnel. In fact, the officers and customers seem to indicate that further improvements to the CIS and IT infrastructure such as browsing speed are necessary, in which the latter part contradicts with the ongoing government's efforts in developing sufficient infrastructure bandwidth. These issues have been transferred over to the customers, which resulted in lower levels of usage and satisfaction. To some extent, the findings show that the external customers are more satisfied with the CIS in many ways compared to the RMC's officers. This is probably due to the fact that the officers are able to accurately see the

shortcomings of the system as compared to their customers who have frequently been exposed to positive images of the system by the policy makers. In some ways, the results also imply that the government has been over-emphasizing on building technology infrastructure without really considering the acceptance of the stakeholders. With little top management support, there is an apparent lack of a conducive environment and facilities needed for successful IT implementation. It is therefore not surprising that the RMC officers and their clients cast doubt on their satisfaction levels.

The results imply that it is imperative for the RMC to reassess their CIS implementation from the perspectives of their internal and external customers. The agency can no longer take a neutral stand and must be open to any forms of reviews in order to stay relevant as an important public service provider. The satisfaction of both the internal and external customers must be fulfilled. In this case, the officers play an important role as they are the front liners to the system. Their perception and satisfaction levels will thus leave important implications to their customers.

To be successful in e-government initiative, vision, in-depth planning and implementation strategy are thus essential factors (Gil-Garcia and Pardo, 2005; Sushil, 2008) in order to reduce the associated risks, costs, and the time wasted (Ghapanchi et al., 2008). Central to e-government implementation is the objectives to be achieved, i.e. to improve the efficiency, transparency, accountability, and effectiveness of governments in better serving their constituents through the delivery of quality service. As such, public sector organizations such as the RMC must be prepared to embrace IT wholeheartedly if it is to become efficient and effective service providers and delivery agents to the citizens. The RMC needs to consider improving its internal management and control (Chu et al., 2008) through a change management mentality (Ghapanchi et al., 2008) so that a conducive environment is enabled to fuel growth of the CIS usage. The policy makers must be made to realize that any e-government initiative would be cumbersome without their full support and commitment. They will have to champion such initiative which must be cascaded down to the departmental levels of the RMC. The management of RMC should be made aware of the importance of CIS usage towards success in public service delivery and allocate adequate budget and resources to facilitate the support given to their officers and customers. It is imperative that the resources are used to improve the IT facilities and infrastructure, hire skillful personnel, and to provide periodic training to both the stakeholders. The training programs provide interaction opportunities among the officers, which might help the RMC to identify future improvements to the CIS.

Related to the above, as e-government involves various stakeholders, it is thus imperative that a holistic approach is taken to increase participation and collaboration with the officers, business entities, citizens and even other government entities when a system is designed or needs improvement, such as in the case of the CIS. It is obvious that the CIS needs to be revamped in order to enhance its usability as stressed in the respondents' answers. This is not uncommon as e-government is still evolving and people are still learning how to develop and manage this new technology. As such, Ghapanchi et al. (2008) suggest that e-government strategies should first target the improvement of their operations and processes and also the level of government's ability to cooperate. In this respect, any system is likely to generate development gains when it is closely adapted to the needs and capacities of the various stakeholders (Bhattacharyya, 2008) who might react differently to an innovation and therefore the degree of adaption (Chan et al., 2000). It is worth remembering that improved

interoperability between public organizations as well as between public and private organizations is of critical importance to make e-government more successful (Gottschalk and Solli-Saether, 2008; Reddick, 2008).

Once a system is designed and ready to be implemented, the policy makers and management of public sectors must think of how to increase the acceptance of the system by its stakeholders. Prior studies have identified factors such as perceived usefulness, trust, and persuasion which exert influence on the acceptance and intention to use e-government applications (Akpinar and Ondin, 2008; Tang et al., 2009). As such, any effort towards increasing acceptance of the CIS must be based on these factors. The officers must be convinced that the use of CIS helps them to complete their tasks on time and expose them to become more creative. At the same time, trust must be built with the customers through effective laws and policies. The customers must be able to see that the CIS meets their needs and that the RMC officers are friendly enough to be reached for advice and even suggestions on how certain aspects of the CIS can be further improved. In addition, it has been found that technology characteristics do not significantly influence the intention to use e-government applications. Therefore, it should provide a hint to the policy makers that continuous investment in technology does not guarantee usage, but rather picking the right technology that is able to fulfill the needs of both the internal and external customers is what matters most. More importantly, the technology and its associated facilities must be friendly enough to encourage usage on top of having sufficient bandwidth and technical integration which are deemed important to fulfill processes timely, quickly, and with minimum of wasted time and corruption (Ghapanchi et al., 2008).

CONCLUSION

In view of the rapid development of ICT infrastructure and environment in Malaysia, there is no doubt at all that the nation is prepared to embrace e-government towards achieving better service delivery performance for its citizens, businesses and other government entities (Tsai et al., 2009) despite the presence of many challenges. In fact, the success of e-government initiative in such as developing country like Malaysia has far-fetched implications. As Ghapanchi et al. (2008) put it, such an enabled government is a momentous opportunity for the developing countries to improve and streamline their government's operations, provide breakthrough performance, and reduce their existing gaps with the developed countries. It is therefore hoped that the recommendations provided above shed some lights to the policy makers and stakeholders in adapting appropriate IT strategies for e-government implementation success. Further, the findings can be used to guide future e-government projects in the country as well as other developing countries. From the research perspective, it is hoped that this study would spur more research in this area, especially among the developing countries.

Perhaps one of the major weaknesses of this study is the small sample size. A larger sample size across all the departments within the RMC and/or with other government agencies and diverse business entities may validate the arguments presented in this paper. It is possible for future studies to consider other important factors such as information quality (Burbridge, 2002; Klischewski and Scholl, 2008) security (Holden et al., 2003; Luna-Reyes and Gil-Garcia, 2003; Roy, 2003; Ryoo et al., 2009), technology incompatibility (Garson, 2003; Holden et al., 2003), policy and political pressures (Brown and Brudney, 2003; Edmiston, 2003; Rocheleau, 2003; Roy, 2003), privacy concerns (Edminston, 2003; Holden et al.,

2003), relationships between governments, business entities and citizens (Rocheleau, 2003), social and economical issues (Brown and Brudney, 2003; Edmiston, 2003; Holden et al., 2003) which are likely to generate important findings. In addition, prior research has shown evidence on the possible significant correlations between the IT issues and demographic factors such as age, education level, broadband access, experience in computer, Internet use, and frequency of Internet usage (e.g. Akpinar and Ondin, 2008; Dwivedi and Williams, 2008). An attempt on this may therefore yield interesting discoveries. Finally, this is a cross-sectional study. A longitudinal study is needed to capture the details.

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The Effect of Variability In Electronic Kanban (e-Kanban) Production System

Wichuta Insalee and Pornthep Anussornnitisarn

ABSTRACT

Traditional mass production manufacturing is not responsive to changing customer demands. It relies on forecasting future demand and scheduling. Mass production systems often have excess inventory, higher WIP levels, and longer quoted lead-times from order to delivery. (Richard 2001) Just-In-Time (JIT) manufacturing approach has triggered various 'pull production systems' that emphasize the importance of production control that react to actual demand rather than future demand forecasts (Karin 2005).

Pull systems authorize parts to be processed in response to the actual demand arrival, control WIP and observe throughput (Spearman 1990). A pull mechanism can be implemented in many ways. The best known is a Kanban policy (Monden 1983). The Kanban control was originally used in Toyota production lines. In the Kanban control system, Production authorization cards, called Kanban, are used to control and limit the releases of parts into each production stage.

The manufacturing operations to respond to changing customer demand. So, The Information Technology is important to improve operation. Particularly in the automotive industries are utilize e- Kanban for their operation. e- Kanban respond actual demands (right products at the right times and in the right amounts) and make-to-order environment (Debra 2001). The next question is the electronic kanban systems can be implemented in most manufacturing. Surprisingly, the answer is NO. There are many variations and factors to be considering

In this article the production example is automotive manufacturing by refer assembly line at Toyota company .The assembly line have main line and sub-line to serve component to each station at main line . Some factors in this paper were fixed as set up time, Economics, Supplier Capacity, Logistic Lead time, part quality from supplier. The main factors to be considered in this study are demand variation, buffer stock at sub-line(component) to support main line, number of workstation at main line, machine breakdown time variation, processing time variation.

Simulation models are used in this paper to illustrate the mechanics systems by use ARENA10.0. To input variable are factors variation which affect with e-Kanban Production system .The result the factors its effect with WIP level (control policy). So this model can specified which factor are the key of factors to implement in e- Kanban system. Then this model can apply for simulate the variation of factor which effect the e-Kanban system. The decision control policy will be judge which condition can be implemented in the manufacturing. So the result can made decision to management team to improve in their manufacturing. The results show the performance of e- Kanban systems using work-in-process levels, backlog order and station utilizations, are main. Hopefully the result can become preliminary guideline who considering e-Kanban implementation.

RESEARCH BACKGROUND AND MOTIVATION

Traditional mass production manufacturing is not responsive to changing customer demands. It relies on forecasting future demand and scheduling. Mass production systems often have excess inventory, higher WIP levels, and longer quoted lead-times from order to delivery. (Richard 2001) Just-In-Time (JIT) manufacturing approach has triggered various 'pull production systems' that emphasize the importance of production control that react to actual demand rather than future demand forecasts (Karin 2005).

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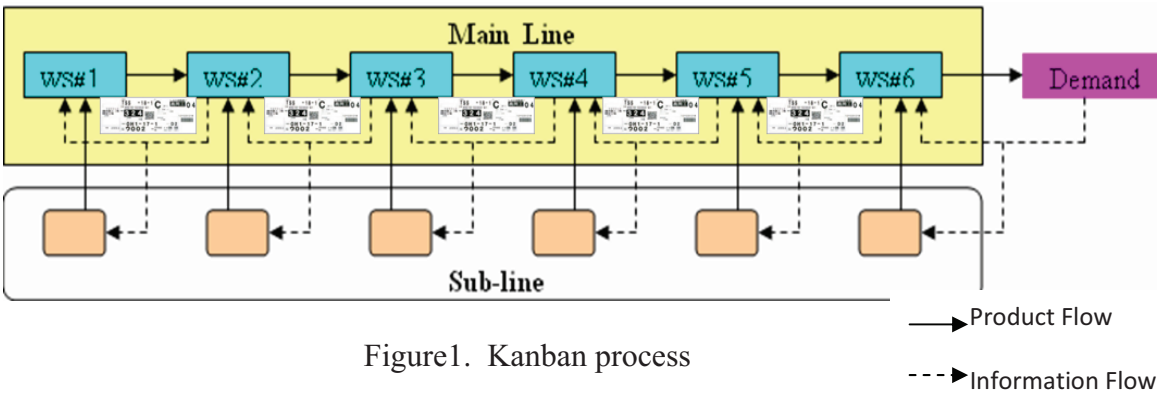

Figure1. Kanban process

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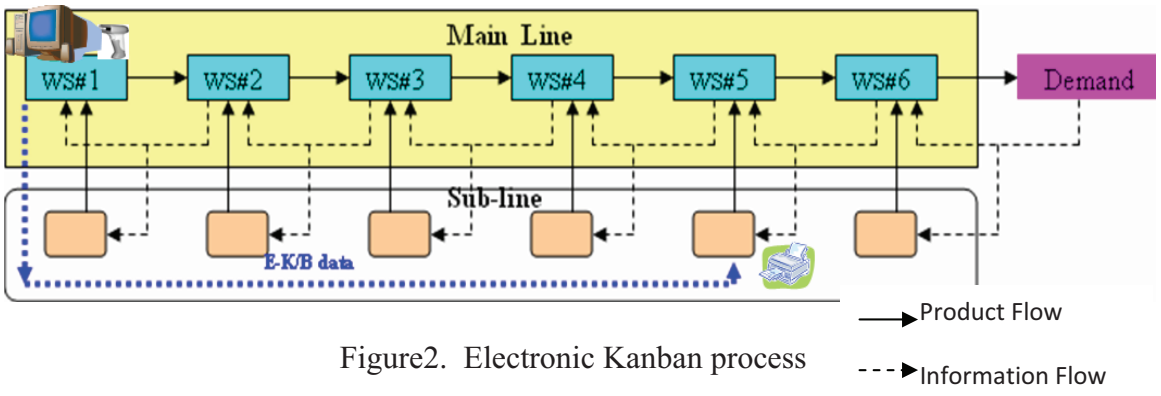

Figure2. Electronic Kanban process

In this study, the production example is automotive manufacturing by refer assembly line at Toyota company .The assembly line have main line 1 line and sub-line to serve component to each station at main line . Some factors in this paper were fixed as set up time, Economics, Supplier Capacity, Logistic Lead time, part quality from supplier. The main factors to be considered in this study are demand variation, buffer stock at sub-line(component) to support main line, number of workstation at main line, machine breakdown time variation, processing time variation.

Simulation models are used in this paper to illustrate the mechanics systems by use ARENA10.0 .To input variable are factors variation which affect with e-Kanban Production system .The result the factors its effect with WIP level (control policy). So this model can specified which factor are the key of factors to implement in e- Kanban system. Then this model can apply for simulate the variation of factor which effect the e-Kanban system. The decision control policy will be judge which condition can be implemented in the manufacturing. So the result can made decision to management team to improve in their manufacturing.

In this study show the results of a simulation study on the performance of e- Kanban systems. The performance measures as work-in-process levels, backlog order and station utilizations, are investigated. Hopefully the result can become preliminary guideline who considering e-Kanban implementation. To explore the potential barriers in other manufacturing plant beside Toyota assembly plant. This study is focus on the impact of variation the performance of e-Kanban system. The purposes of this study are

1. To find out key factors which effect to implement in e-Kanban system in the assembly line
2. To find out variation of factors are impact in the process
3. To simulate factors by generate suitable model

LITERATURE REVIEW

Kanban and e-kanban

Kanban, meaning card or marker in Japanese, is the more widely known and recognized type of pull system. A Kanban pull system is sometimes referred to as the Toyota Production System (just-in-time manufacturing using a Kanban pull system) (Monden ,1981)
A traditional card based kanban system has some limitations that can be improved with an electronic kanban (e-Kanban) system. The kanban system itself includes some nonproductive work caused by card handling. The kanban system is difficult to adjust to production mix changes because the cards have to be collected and replaced with new ones(Richard P. Marek , 2001).

Electronic kanban systems or closely related kanban type systems have been developed during recent years.However, the scientific reports and descriptions of electronic kanban system or their implementation are rare.Several articles describe the advantages of electronic signals over the cards. Some articles notice that electronic kanbans are in use to some extent, but they do not

include more detailed information of the principles and practices utilized. Motor vehicle manufacturers have been the first companies reported to have electronic kanban systems in place. Rover used as early as 1986 an EDI based signaling system used to pull materials from the suppliers.General Motors was reported in 1990 to have bar-code based pull production system. Toyota studied the possibilities of replacing the card based kanban with an electronic system in 1999. Toyota had a working interned based kanban solution in their factories in France and England in the year 2000 to pull materials from suppliers.The suppliers attach a bar-code to each delivered container, which is used for batch identification.After the material is used the bar-code is removed from the container. However, the practice described above has some push control features. The orders or pull signals are sent based on the production schedule, not the realized production or system status. Ford has implemented a simple bar-code based pull production system called SMART. BMW is reported to have an electronic kanban system in place.ERP vendors such as SAP have included kanban functionality in their products. The SAP solution utilizes RFID tags attached to containers to automate batch identification and location tracking. The manufacturing decisions can be made based on accurate information of production batch status.Most of the electronic kanban systems described use RFID-codes or bar-codes in production batch identification.[10] [16] Bar-codes are applied more often to manage material flow between companies, because the containers are used for different batches. RFID tags are more applicable in inter-company situations because the same containers are used many times. The earlier mentioned Toyota example is limited only to pull the materials from the suppliers. Toyota still uses card-based kanbans in its own manufacturing operations.

An e- kanban system has many advantages over the traditional kanban system. It is as simple as the traditional kanban, but signals are transferred faster. Several writers list the advantages of the e- kanban system:

- Removes the problem of lost cards
- The demand need is delivered right time
- Time and effort needed cards handling is minimized
- Fast and effective optimization of kanban cards
- Minimizes the material shortages
- Improves the supply chain transparency
- Helps to analyze the supplier efficiency

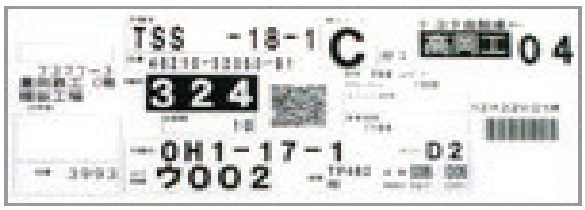

Figure3: Kanban Card

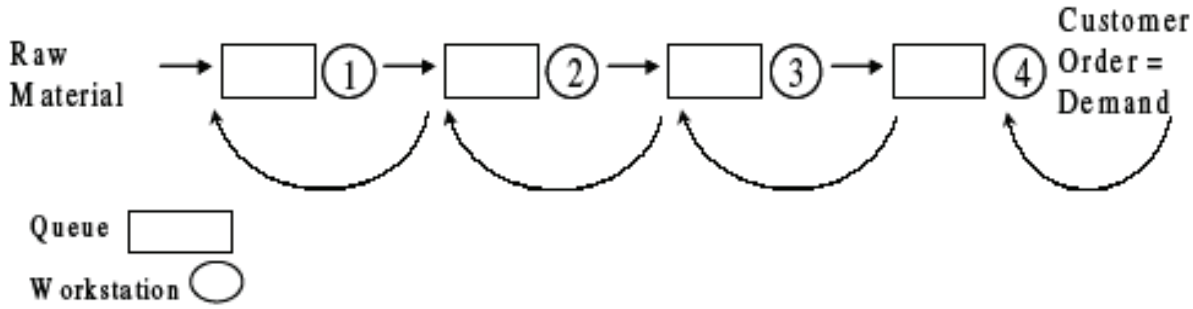

Figure.4: Kanban Pull System

Just-in-time production system

Just-in-time(JIT) system or Toyota production system (TPS). Developed mostly within Toyota and with its suppliers in the 1950s and 1960s, the JIT/Toyota system was largely unknown in the West until the late 1970s. The word got out in 1977 in two English language articles. One, written by Toyota managers, was published in the International Journal of Production Research (Sugimori et al., 1977). The other appeared in American Machinist (Ashburn, 1977).Not much changed until 1981 when JIT/TPS quickly became a hot topic, aired in assorted books, articles, conferences, lectures, and management consultants' advocacy. Today, many industry people who are involved appear to be unaware that what is now called lean manufacturing was in full bloom, notably in the United States, in the early 1980s. A common perception seems to be that the movement began in the 1990s following publication of The Machine That Changed the World (Womack et al., 1990). The following are a few notable markers of the rise beyond Japan of JIT/ TPS/lean in the 1980s:

In recent years, a new production control concept, called Just-in-time production (JIT),has been initiated in Japan by Toyota Company and adopted by many companies around the world to aid management in improving production performance. The basic concept of JIT production control system is to reduce in-process inventories to the lowest level possible by operating the line and each station according to the demand. JIT systems are also referred to as pull systems, since a succeeding station withdraws or pulls parts from the storage of a preceding station only at the rate and at the time it has completed its parts. (Mehmet Savsa ,1995)

JIT production control systems have been reported and described in various professional journals. While some of the papers deal with the general philosophy and review of the JIT systems, others deal with the modeling and analysis aspects of such systems. Among others, Kimura and Terada,Schonberger, Monden, Im [S], Miltenburg and Wijngaard [IS] and Mejabi and Wasserman deal with the basic concept and philosophy of JIT systems. Research in the modeling and analysis area can be classified as: mathematical models, simulation models and case studies. Phlipoom et al. [S], Bitran and Chang, Wang and Wang [lo],Bard and Golany and Li and Co have developed different mathematical models, such as dynamic programming, integer programming and Markovian models to describe the behavior of JIT systems and to

determine the optimum number of kanbans (work-in-process) between stations. However, it has been realized that the development of mathematical models sometimes require restrictive assumptions which may not be realistic. Therefore, some investigators have tried to develop simulation models to describe the behavior of these systems.Huang et al., Schroer et al. [14], Rees et al., Sarker and Harris, Sarker and Fitzsimmons and Sarker, have presented different simulation models and studied JIT systems. Chu and Shih have reviewed and compared several previous simulation studies on JIT production systems. Cadley et al. have studied the impact of implementing JIT in US firms using simulation modeling. Finch and Cox have examined JIT application to a small manufacturing line with a practical application. The best literature review on the subject was carried out by Golhar and Stamm who have reviewed and classified 860 articles related to JIT production control system. Mehmet SavsaP , Abdullah Al-Jawinib ,1995)

Just-in-time systems make use of cards (referred to as kanbans) which are attached to part containers and carry the necessary information with them. A kanban system is an information system to harmoniously control the movement of parts between stations.

In this paper, I present the results of a simulation study on the performance of JIT systems. In particular, the effects of processing time and demand variability, buffer stock of components, Breakdown time variation and the line length (number of workstation) on such performance measures as backlog quantity, work-in-process levels and station or machine utilizations, are investigated.

METHODOLOGY

Data collection

There are many factors that concern e-Kanban system such as demand variation, demand distribution, buffer stock, processing time variation and distribution, number of workstation, breakdown time variation and distribution, product type variation. So that before collect the data researcher interview production manager to screening the factors. The result, the main factors are considered have total 5 factors.

Factor A : Demand Variation
Factor B : Buffer
Factor C : Processing time variation
Factor D : Number of workstation
Factor E : Breakdown time variation

All data is collected from actual data of the year 2008 is used for this research

Design of Experiment

In this experiment, statistical software was applied to design and simulate suitable experiment for the raw data collection in screening process, analyze the result, including design the response surface of experiment to determine the appropriate operating condition for factor effect analysis. The application of statistical software is to analyze and evaluate the results from the experiment.

In the first step, there were many influenced factors that must be considered. Some of them have significant effects on the response variables and some have less or none at all. We could not apply the full factorial design at this step because of the limitation of time and resources. Fractional factorial design was selected at the first step to screen the influenced factors. The fractional factorial design or Taguchi design resolution for this experiment was resolution I designs (3_I^{5-2})= 27 runs. It mean 5 factors,3 levels and no. of run 27 run.For this design, only main factors can be estimated (main effects are all confounded with any order interaction) resolution I .

In the second step, the interaction effects must be considered. Fractional factorial design was selected at the second step by Taguchi's design shown in table 7. This step select two set of interaction factor to be considered. There are AB (Demand and buffer), AC (Demand and processing time), AD (Demand and Line length), BC (Buffer and processing time), BD (Buffer and Line length) and CD (Processing time and Line length) effects. Other factors are fixed when 2 factors interaction be considered.

The level of factor is fixed as below.

Factor A (Demand): Normal distribution with mean 4 min and standard deviation 0.586
Factor B (Buffer): Zero buffer for safety stock
Factor C (Processing time): Constant 4 min/unit
Factor D (No. of workstation): 10 workstations
Factor E (Breakdown time): Mean time and standard deviation time before failure

Results

Initially, the experiments are planned to identify the most important factors of the model. Then, these factors are used as input data for optimization software. Also, this model is optimized using all factors as input data in order to compare the results. The optimization software is ARENA 10.This chapter will run simulation model including the interpretation of the obtained results .Also this chapter has concluded the analysis of factor effect. The response variables are collected the data for each run to 27 runs shown in Figure 6.

Figure 6: The 3_I^{5-2} Design Matrix Principal Fraction and Results

	Factor					Response		
	Demand	Buffer	Processing	WS	Breakdown	Avg.WIP level	Lost sale(unit/day)	Avg. M/C utilization
Run no.	A	B	C	D	E	X	Y	Z
1	1	1	1	1	1	1.8721	48.433	0.704
2	1	1	1	1	2	1.8721	48.433	0.700
3	1	1	1	1	3	1.8721	48.433	0.697
4	1	2	2	2	1	0.0000	54.000	0.754
5	1	2	2	2	2	0.4003	55.633	0.754
6	1	2	2	2	3	0.4002	55.500	0.744
7	1	3	3	3	1	0.7664	55.833	0.874
8	1	3	3	3	2	0.7695	56.200	0.871
9	1	3	3	3	3	0.7423	55.033	0.871
10	2	1	2	3	1	0.9351	50.733	0.886
11	2	1	2	3	2	0.9836	52.533	0.880
12	2	1	2	3	3	1.0302	54.233	0.875
13	2	2	3	1	1	2.6353	52.600	0.645
14	2	2	3	1	2	2.6353	52.600	0.644
15	2	2	3	1	3	2.6353	52.600	0.644
16	2	3	1	2	1	4.0402	49.967	0.716
17	2	3	1	2	2	3.9698	49.300	0.712
18	2	3	1	2	3	4.1245	50.933	0.712
19	3	1	3	2	1	5.1465	61.933	0.730
20	3	1	3	2	2	5.1727	61.933	0.728
21	3	1	3	2	3	5.1648	62.567	0.723
22	3	2	1	3	1	1.2164	52.467	0.875
23	3	2	1	3	2	1.1957	51.367	0.876
24	3	2	1	3	3	1.1716	51.633	0.875
25	3	3	2	1	1	2.7651	50.033	0.673
26	3	3	2	1	2	2.7651	50.033	0.671
27	3	3	2	1	3	2.7651	50.033	0.674

Main Effect

The results obtained for each run is shown in table 8. The performance measure for response variable "X" is WIP level by using ANOVA.
It's calculated expected mean square then the next step is to calculate F value. After completing the F value, calculate P value from degree of freedom, depended on the number of replicate, for screening the significant factors.

The main factor effect by *average WIP level* response stand for *"X"* is shown in Figure 7. To determine the main factor effect from P-value its significant at confidential interval 95 % when less than 0.05 respectively. The P-value shows the main factor A, B, C and D effect to average WIP level.

Figure 7: Response factor "X" for main factor effect by using ANOVA

Analysis of Variance for X, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	2	0.8907	0.8907	0.4454	416.28	0.000
B	2	1.5919	1.5919	0.7959	743.96	0.000
C	2	0.7181	0.7181	0.3590	335.59	0.000
D	2	9.3857	9.3857	4.6928	4386.34	0.000
E	2	0.0011	0.0011	0.0005	0.50	0.618
Error	16	0.0171	0.0171	0.0011		
Total	26	12.6045				

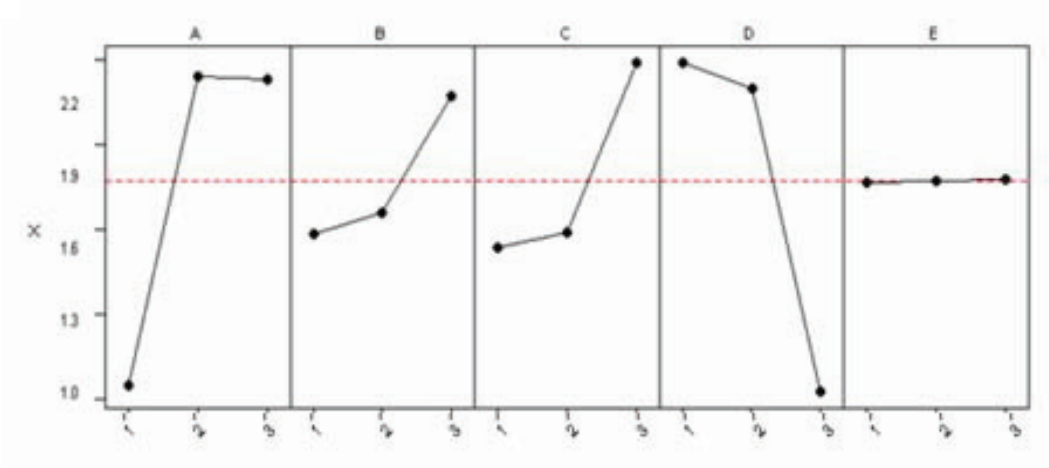

Figure 8 Main effects plot for "X" average WIP level

See Figure 8 .It is noticed that factor A=Demand variation, B=Buffer at sub-line and C=Processing time variation have positive effect. These factors increase the WIP level when they are increased (level 3). Another factor D= Number of workstation has negative effect that decrease the WIP level when they are increased (level 3).

The main factor effect by *Total backlog orde*r response stand for *"Y"* is shown in Figure 9. To determine the main factor effect from P-value its significant at confidential interval 95 % when less than 0.05 respectively. The P-value shows the main factor A, B, C and D effect to total backlog order.

Figure 9: Response factor "Y" for main factor effect by using ANOVA

Analysis of Variance for Y, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	2	68.893	68.893	34.446	62.45	0.000
B	2	15.461	15.461	7.730	14.02	0.000
C	2	255.887	255.887	127.943	231.97	0.000
D	2	53.138	53.138	26.569	48.17	0.000
E	2	2.350	2.350	1.175	2.13	0.151
Error	16	8.825	8.825	0.552		
Total	26	404.553				

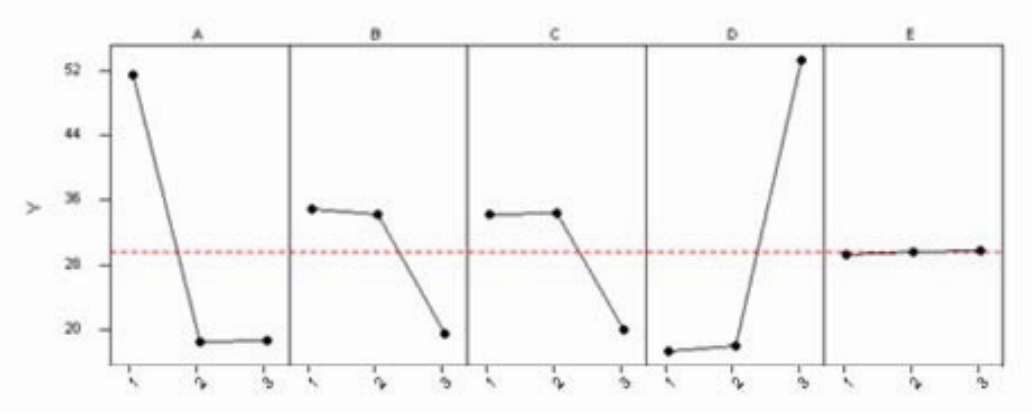

Figure 10: Main effects plot for "Y" total backlog order

See Figure 10 .It is noticed that factor A=Demand variation, B=Buffer at sub-line and C=Processing time variation have negative effect. These factors increase the backlog order when they are decreased (level 3).The another factor D= Number of workstation has positive effect that increase the backlog order when they are increased (high level).

The main factor effect by *average machine utilization* response stand for *"Z"* is shown in Figure 11. To determine the main factor effect from P-value its significant at confidential interval 95 % when less than 0.05 respectively. The P-value shows the main factor A, B, C and D effect to average machine utilization.

Analysis of Variance for Z, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	2	0.003633	0.003633	0.001816	283.06	0.000
B	2	0.001338	0.001338	0.000669	104.23	0.000
C	2	0.001980	0.001980	0.000990	154.30	0.000
D	2	0.197782	0.197782	0.098891	1.5E+04	0.000
E	2	0.000098	0.000098	0.000049	7.64	0.005
Error	16	0.000103	0.000103	0.000006		
Total	26	0.204933				

Figure 11: Response factor "Z" for main factor effect by using ANOVA

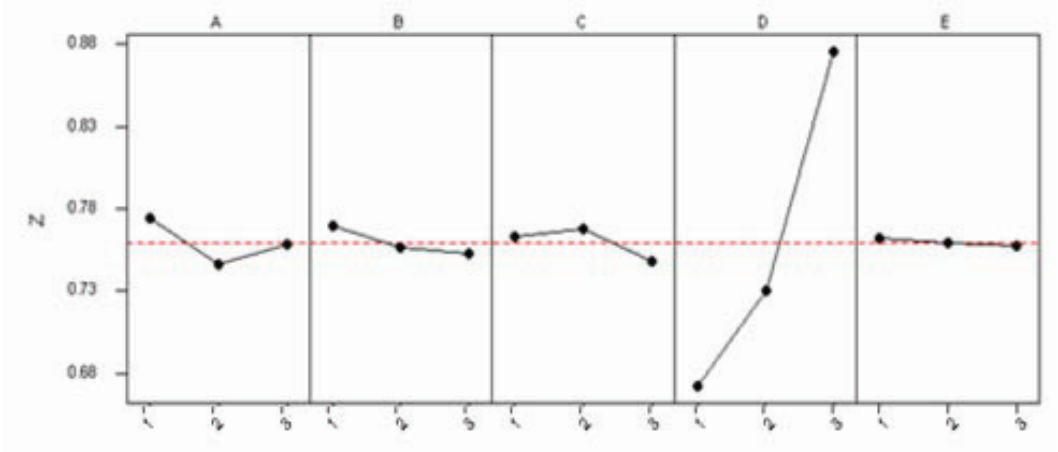

Figure 12: Main effects plot for "Z" average machine utilization

See Figure 12 .It is noticed that factor, B=Buffer at sub-line and C=Processing time variation have negative effect. These factors increase the average machine utilization when they are decreased (level 3). Another factor D= Number of workstation has positive effect that increase the average machine utilization when they are increased (level 3). It's seem factor A=demand variation that can't identify positive or negative effect with average machine utilization .By the way at zero demand variation level is maximize of average machine utilization.

These figure gives a good indication that four factors must be effect to average WIP level , total backlog order and average machine utilization, as demand variation, buffer at sub-line, processing time variation and number of workstations.

However, to have conclusive results, it is necessary to verify the interactions among factors.

Interaction Effect

The two-factor interaction between factor A and Factor B is shown in table Figure 13-16. The ANOVA for response "X" show AB interaction hasn't significant effect. From Figure17&18, it is noticed that the interactions between AB=Demand variation and buffer lead to same results by minimize of average WIP level and total backlog order. Taking into consideration interaction AB it is clear that factors A must be kept at level 1 (zero variation) and factors B must be changed levels.

Figure 13: Response factor "X" for AB interaction factor effect by using ANOVA

Analysis of Variance for X, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	1	0.0132540	0.0018934	0.0018934	189.34	0.000
B	1	0.0000000	0.0000000	0.0000000	0.00	1.000
A*B	1	0.0000000	0.0000000	0.0000000	0.00	1.000
Error	5	0.0000500	0.0000500	0.0000100		
Total	8	0.0133040				

Table 14: Response factor "Y" for AB interaction factor effect by using ANOVA

Analysis of Variance for Y, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	1	9.3750	1.3393	1.3393	53.57	0.001
B	1	0.0000	0.0000	0.0000	0.00	1.000
A*B	1	0.0000	0.0000	0.0000	0.00	1.000
Error	5	0.1250	0.1250	0.0250		
Total	8	9.5000				

Table 15 : Response factor "Z" for AB interaction factor effect by using ANOVA

Analysis of Variance for Z, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	1	0.0001815	0.0000259	0.0000259	28.81	0.003
B	1	0.0000000	0.0000000	0.0000000	0.00	1.000
A*B	1	0.0000000	0.0000000	0.0000000	0.00	1.000
Error	5	0.0000045	0.0000045	0.0000009		
Total	8	0.0001860				

Figure 16: The 3^2 design Matrix Principal Taguchi and Results for AB

	Demand	Buffer	Avg.WIP level	Lost sale(unit/day)	M/C utilization
Run No.	A	B	X	Y	Z
1	1	1	1.872	48.433	0.726
2	1	2	1.872	48.433	0.726
3	1	3	1.872	48.433	0.726
4	2	1	1.914	49.433	0.722
5	2	2	1.914	49.433	0.722
6	2	3	1.914	49.433	0.722
7	3	1	1.966	50.933	0.715
8	3	2	1.966	50.933	0.715
9	3	3	1.966	50.933	0.715

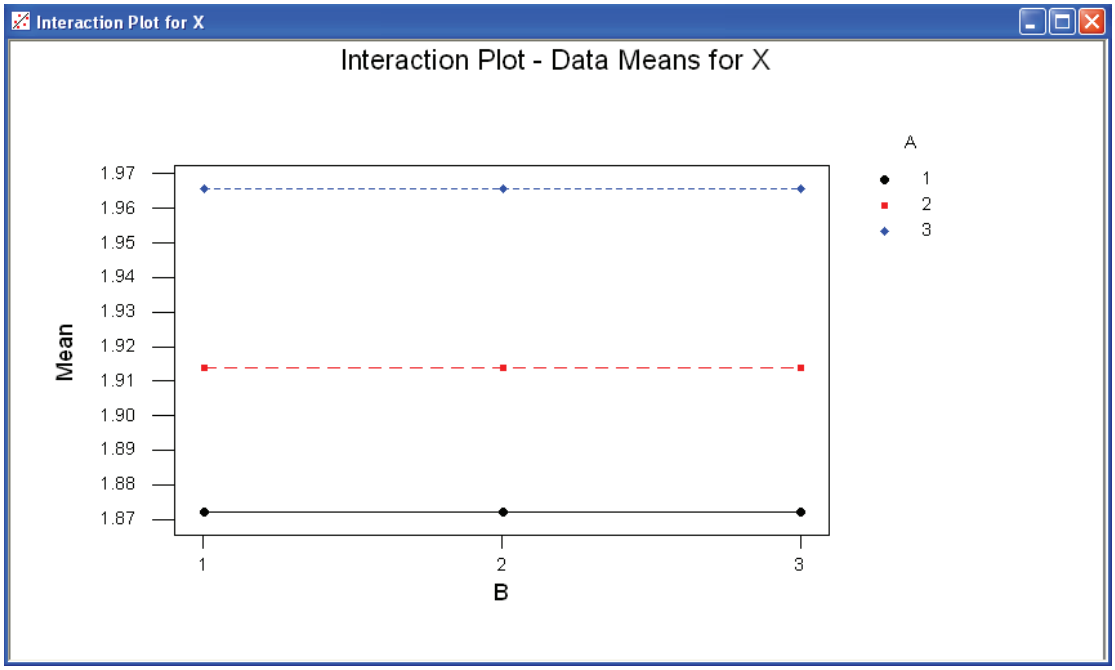

Figure 17: Interaction effect of AB by average WIP level response

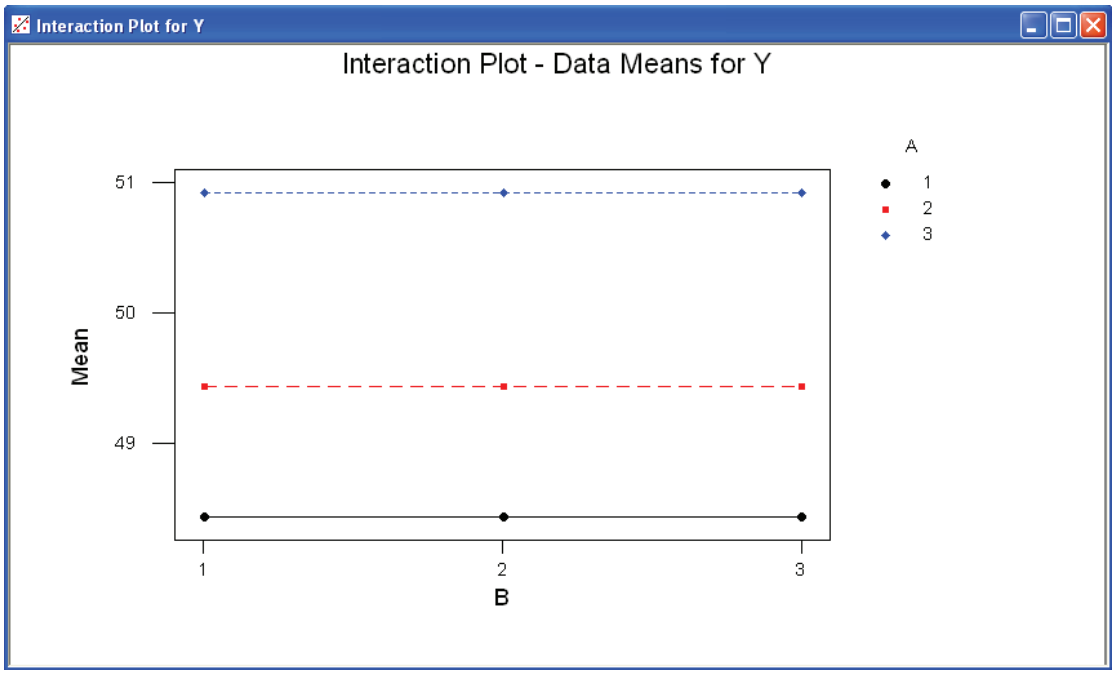

Figure 18: Interaction effect of AB by total backlog order response

In the same way, the interactions between AB=Demand variation and buffer lead to maximize of average machine utilization. Taking into consideration interaction AB it is clear that factors A must be kept at level 1(zero variation) and factors B must be changed levels shown in Figure 19.

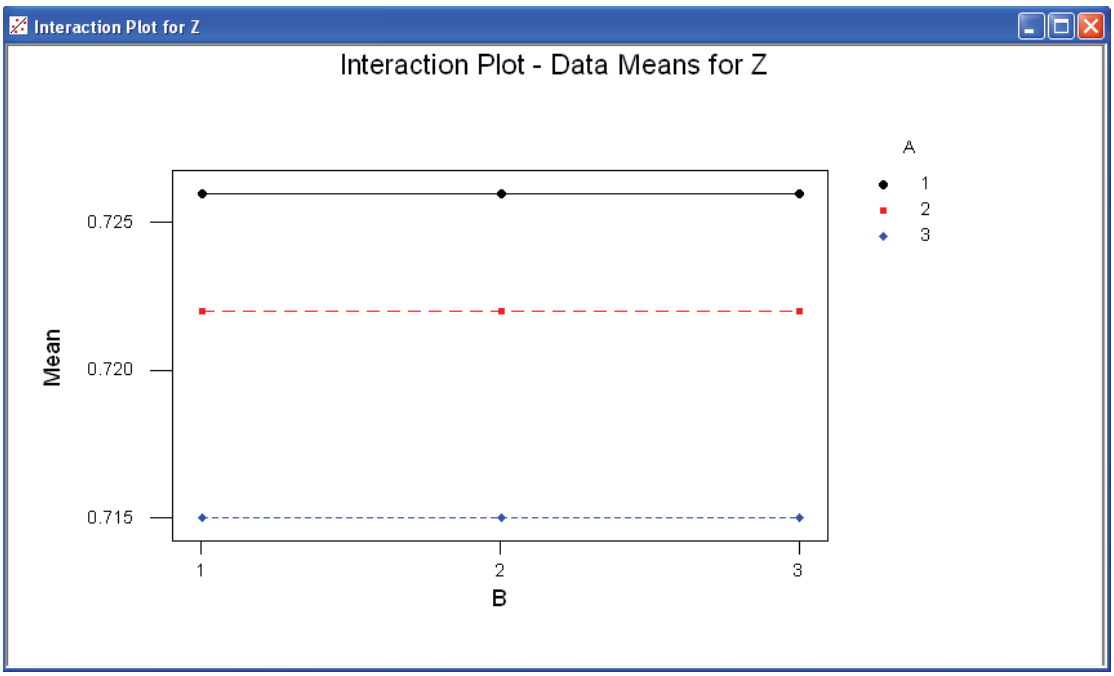

Figure 19: Interaction effect of AB by average machine utilization response

The two-factor interaction between factor B and Factor C is shown in Figure 20-23. The ANOVA for response "X" show BC interaction hasn't significant effect. From Figure 24 & 25, it is noticed that the interactions between BC= buffer and processing variation lead to same results by minimize of average WIP level and total backlog order. Taking into consideration interaction BC it is clear that factors C must be kept at level 1 (zero variation) and factors B must be changed levels.

Figure 20: Response factor "X" for BC interaction factor effect by using ANOVA

Analysis of Variance for X, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
B	1	0.00000	0.00000	0.00000	0.00	1.000
C	1	1.10425	0.44170	0.44170	5.24	0.071
B*C	1	0.00000	0.00000	0.00000	0.00	1.000
Error	5	0.42136	0.42136	0.08427		
Total	8	1.52561				

Figure 21: Response factor "Y" for BC interaction factor effect by using ANOVA

Analysis of Variance for Y, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
B	1	0.000	0.000	0.000	0.00	1.000
C	1	60.179	24.072	24.072	13.65	0.014
B*C	1	0.000	0.000	0.000	0.00	1.000
Error	5	8.820	8.820	1.764		
Total	8	68.999				

Figure 22: Response factor "Z" for BC interaction factor effect by using ANOVA

Analysis of Variance for Z, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
B	1	0.0000000	0.0000000	0.0000000	0.00	1.000
C	1	0.0001815	0.0000726	0.0000726	0.76	0.425
B*C	1	0.0000000	0.0000000	0.0000000	0.00	1.000
Error	5	0.0004805	0.0004805	0.0000961		
Total	8	0.0006620				

Figure 23: The 3^2 design Matrix Principal Taguchi and Results for BC

	Demand	Buffer	Avg.WIP level	Lost sale(unit/day)	M/C utilization
Run No.	A	B	X	Y	Z
1	1	1	1.872	48.433	0.726
2	1	2	1.872	48.433	0.726
3	1	3	1.872	48.433	0.726
4	2	1	1.914	49.433	0.722
5	2	2	1.914	49.433	0.722
6	2	3	1.914	49.433	0.722
7	3	1	1.966	50.933	0.715
8	3	2	1.966	50.933	0.715
9	3	3	1.966	50.933	0.715

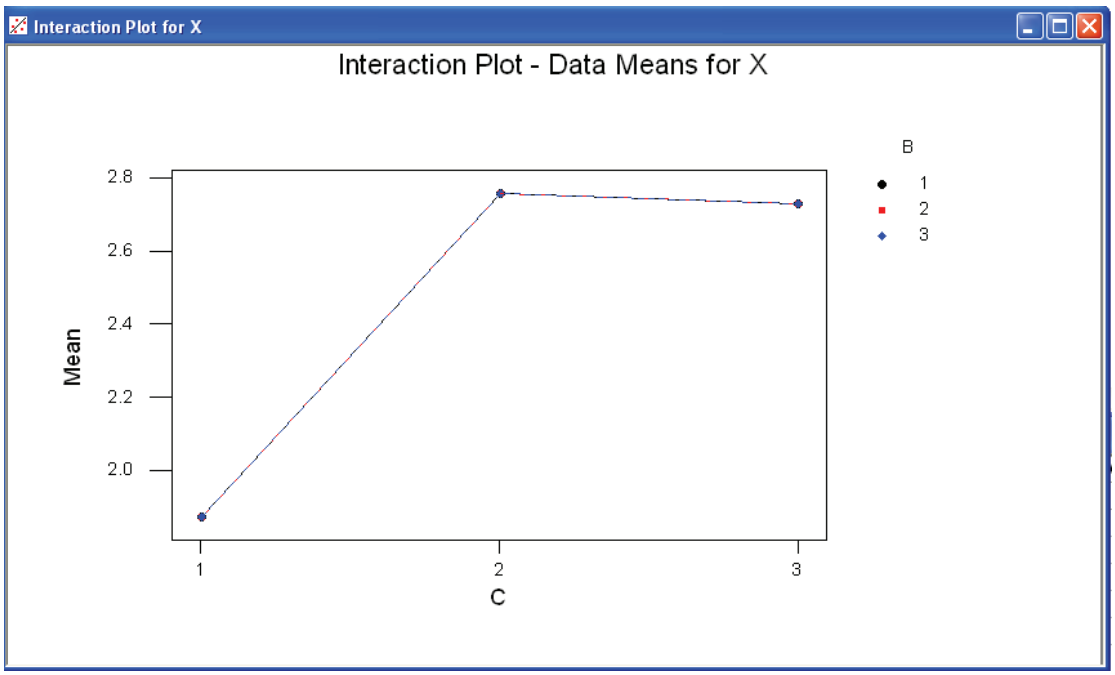

Figure 24: Interaction effect of BC by average WIP level response

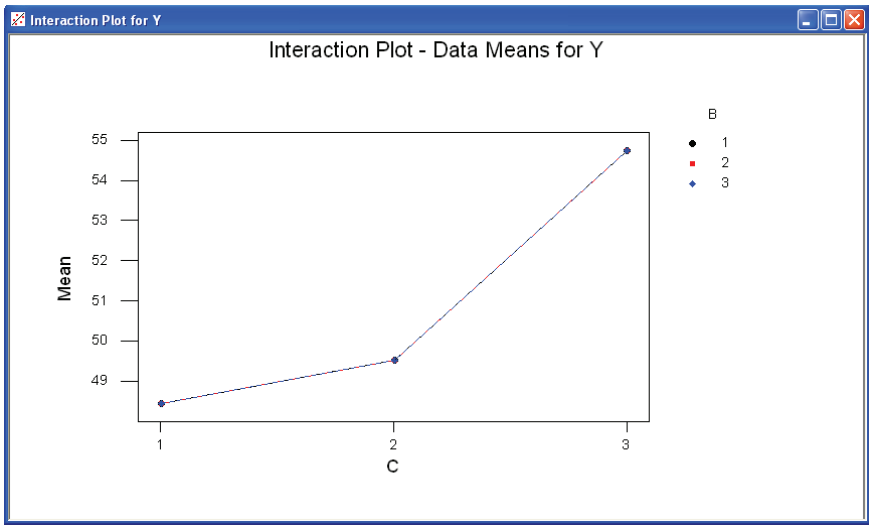

Figure 25: Interaction effect of BC by total backlog order response

In the same way, the interactions between BC= buffer and processing variation lead to maximize of average machine utilization. Taking into consideration interaction BC it is clear that factors C must be kept at level 2 (zero variation) and factors B must be changed levels shown in Figure 26

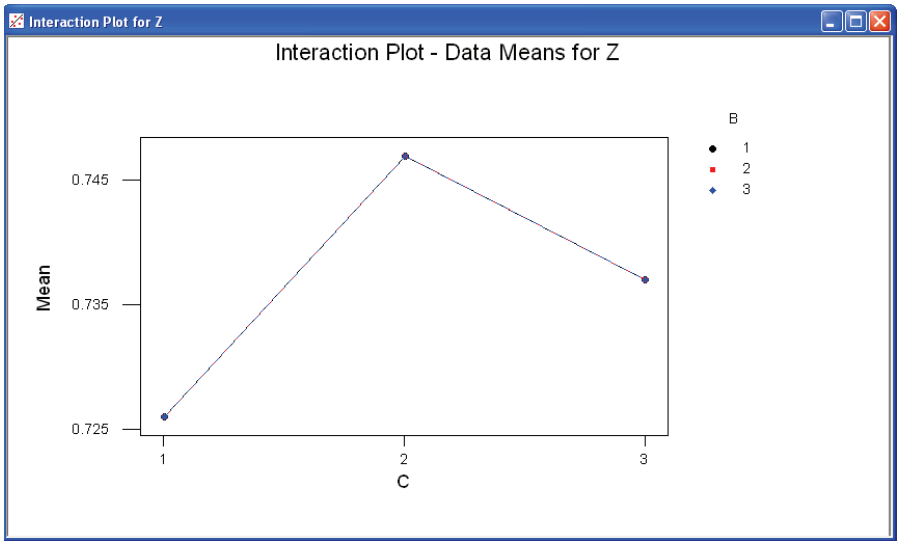

Figure 26: Interaction effect of BC by average machine utilization response

CONCLUSION

The main purpose of this study was to develop a simulation model, to investigate the effects of different operational factors on the performance of e-Kanban production system. Three performance measures were evaluated under different operational conditions, including average WIP level, backlog order and machine utilization. Furthermore, an experimental design was set up to study the effects of main and interaction of different factors on performance measures.

Main effect

Results of the ANOVA are summarized for all three performance measures (the responses) in Figure 27. The " * " indicates that the effect of the factor was significant at 5%; the (+) indicates that the effect of the factor should set at high level; the (-) indicates that the effect of the factor should set at low level. From the simulation results we observed that the WIP level, backlog order and machine utilization are significantly affected by the variability in demand interval, buffer, processing times and number of workstation. On the other hand the variability in breakdown time does not have a significant effect on response variables

Figure 27: Analysis of variance results of main factor for different performance measures

Factor	Main Factors Performance measures (response)		
	WIP level	Backlog order	Machine utilization
A (Demand interval)	*(-)	*(+)	*(-)
B (Buffer)	*(-)	*(+)	*(-)
C (Processing time)	*(-)	*(+)	*(-)
D (No.of workstation)	*(+)	*(-)	*(+)
E (Breakdown time)			

Note: * significant at 5%; (+) high level of factor should set up or (-) low level of factor should set up

Interaction effect

The two- interaction effects were not significant in all performance cases at significant level 95%. So this system hasn't two-factor effect to WIP level, backlog order, machine utilization.

General Practice

The other company which apply e-Kanban system to use with your own. The results refer from simulation would set factor parameter as,

a. Demand variation should be zero variation, it's closed to constant
b. Buffer should be zero, because buffer its take more space and protect e-Kanban system. So this system will inform production plan to each process in advance
c. Processing time variation should be zero variation, it's closed to constant
d. Line length or number of workstation should be longer. The job of each workstation is decreased so the error should be reduced accordingly. It makes less of impact to the system.

Recommendation

a. By backlog order reduction would has overtime production / add production line or plant (bridge production concept)
b. Some factor in some performance measure its not good result. So increasing replication for running model its quite be good for interpret the result.
c. There is the factor to be considered as number of product type which may effect to performance measure. It's should trial this factor for next study.
d. For complex system simulation, where the simulation itself is very time-consuming, the Factorial Designs make possible some special approaches as response surface methods (Kleijnen 1998) which are recommendations for future works.

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AN APPLICATION OF ANALYTIC HIERARCHY PROCESS TO VOICE OVER INTERNET PROTOCOL SELECTION

Chuvej Chansa-ngavej[1*], Shinawatra University, Thailand
chuvej@shinawatra.ac.th
Akekachat Srijuntub[2], Shinawatra University, Thailand
akekachat.p@egat.co.th

ABSTRACT

The aim of this research is to establish the criteria for selecting the most appropriate Voice over Internet Protocol (VoIP) technology using the Electricity Generating Authority of Thailand (EGAT) as the case study company. Seven EGAT experts in telecommunication systems agreed to participate in this research. In-depth interviews with experts were arranged in order to gather expert opinions for refining the criteria from those gathered from past researches and to screen the alternatives for final selection. Analytic Hierarchy Process (AHP) is applied to investigate the priority of the established criteria and evaluate the preference of each alternative. The opinions were collected from the experts using the structured survey questionnaire.

The result of this research indicates that highest priority was given to "benefit criteria" rather than "low cost criteria". Under benefit criteria, intangible benefit subcriteria received priority that was higher than that of tangible benefit. Highest preference was given to the pure IP-PBX VOIP alternative based on the four main criteria ranked in the order of importance from high to low as follows: benefit, low cost, technical feasibility, and low risk. The choice of the most appropriate technology in this case was found to be rather insensitive to changes in the importance of each main criterion. Managerial implications are discussed.

Keywords: Analytic Hierarchy Process, Multiple-Criteria Decision Making, Innovative Technology Selection

INTRODUCTION

Communication system technology is one of the key tools to ensure the system reliability, especially the power system control, of Electricity Generating Authority of Thailand (EGAT), a state enterprise responsible for electricity generation in Thailand. Various communication systems have been installed in EGAT, such as data-communication network, telecommunication network and information system, to support internal operation and core business of EGAT. Communication system division of EGAT has undertaken responsibility for planning, designing, installing, deploying and maintenance every communication system within EGAT.

The communication systems were continuously improved and developed to support core business to ensure availability and reliability, especially regarding electricity generation and transmission system. EGAT has many substations, with power plants and dams located in virtually all provinces in Thailand. Therefore, EGAT's employees dispersedly work throughout the kingdom. Internal communication systems of EGAT, such as the wireless system and the telephone system, can help them to communicate from anywhere at any time.

The telephone system in EGAT is the main communication system used to support both administrative work and power system control.

At present, employees at remote site can communicate with other employees using telephone sets, faxes and modems at headquarters through EGAT's telephony network. However, many pieces of equipment of the telephony system are used beyond its designated life cycle, and thus most of them become inoperable and require a great deal of effort and cost to operate and maintain. Routine maintenance and breakdown repair cost increase, energy use may increase, even more operation time may be required, and more undesirable consequences would follow. Also, the impact of changes in technology is found to vary among different types of assets. In general, the costs per unit of operation, as well as quality and other factors, are favorably impacted by changes in technology, which result in replacement of existing system with new and better challengers. Replacement of legacy system is expected to retain the cost-effectiveness of telephone system, reduce resources for operation and maintenance, and increase productivity.

This study focuses on the evaluation and selection of the appropriate VoIP technology from economic and non-economic perspectives. The technology is planned to replace legacy voice communication equipment at headquarters, control center, and remote sites across its communication network. VoIP is expected to increase employee productivity with integrated voice and data applications such as collaborative multimedia applications and mobile communications solutions supporting both administrative tasks and mission-critical tasks like power system control. The main aim of the research is to establish the set of criteria suitable for the selection of innovative technology for such a technology-intensive firm as EGAT.

METHODOLOGY

Decision making process model of Simon (1977) and AHP model were used to assist EGAT in analyzing the VoIP adoption options. These methodologies can be used to solve the conflicting issues among different viewpoints within an organization. This study integrated the three-phase model of Simon (1977) decision making process into the methodology.

Intelligence phase – Intelligence phase is concerned with identifying an enriched and consensual view of the problem. This was conducted entirely through in-depth interviews with a mixture of face-to-face and telephone sessions. It is important to allow the group of experts the opportunity to discuss, understand, and define the problem fully.

Design phase – Design phase is concerned with identifying or designing list of alternatives and criteria. Data were gained through from literature reviews in order to obtain validated alternatives and criteria. A validated list of alternatives and an initial list of objectives were presented to the seven experts. Experts individually involved in discussions about their opinion on the lists to refine and augment a list of criteria and alternatives of VoIP technology. For complex criteria that cannot be directly evaluated, they are decomposed into a set of sub-criteria, both qualitative and quantitative ones. After that a revised list of alternatives and a refined list of criteria were created, which were presented to the experts to gain approvals. The selection of criteria is described under the Criteria Selection heading.

Choice phase – The Analytic Hierarchy Process served as the foundation of the choice phase. One of the strengths of the AHP is to provide a clear, organized, and logical view of the decision problem.

The data requirement used in this study is described below under the Data Requirement heading. There are two instruments used to collect the required data. The first instrument, described as such, is used in *intelligence phase* and *design phase.* The second instrument, described under another heading, is used in the choice phase.

Data Requirement

The data required for this research were generated by two instruments. The EGAT decision makers and experts on the topic of VoIP responded to these research instruments. The first research instrument in this research used in-depth interview. Each expert responds to questions on a face-to-face basis. The interview was recorded (i.e. typewritten) and respondents were given the opportunity to re-evaluate their original answer. The evaluation of this instrument led to quantifying experts' judgments using the second instrument which is the AHP. It was used to obtain preference weights of validated criteria from EGAT experts. The criteria were composed of tangible and intangible criteria. The result of preference weights was used in ranking VoIP solution of EGAT. The AHP technique has proved useful in eliciting objectives and ranking policy options as well as in checking for consistency of the statements of stakeholder groups. Implementation of this approach requires a complex data elicitation process.

Recruitment of Experts

AHP considers both qualitative and quantitative approaches to research and combines them into a single empirical inquiry. It is to be noted that the AHP approach is a subjective methodology that does not necessarily involve a large number of experts to take part in the process. Generally, in an academic research, a small sample might only provide a rough picture. However, with reference to tacit information about important business decisions, opinions from a small group of key executives of the company are considered to be sufficient for generating reliable and useful results. Sometimes, some very important business decisions involve discretion on the part of only one person, usually the managing director of the company, who is the one and only one to fill in the questionnaire (Cheng & Li, 2001).

A list of potential participants who had strong experience was generated, at least five years, on telephone system of EGAT. The potential participants were contacted for participation in the study. Seven experts involved in decision-making, planning, design, maintenance, and operation of telephony system of EGAT were asked to participate in this study. They were given the complete picture about the objective of the study and specifically the VoIP system evaluation. Profiles of the subjects who agreed to participate in the research are listed in Table 1.

Table 1 Profiles of the experts participating in this research

Expert	Position	Experience (years)		Description of experience
		Telephone System	VoIP System	
1	Engineer, level 5	5	3	Planning and designing of telephone system Preparing bidding document Cooperate with internal customer
2	Engineer, level 7	20	3	Operating and maintain for Hybrid IP-PBX and Pure IP-PBX
3	Engineer, level 7	29	4	Operating and maintain for Hybrid IP-PBX and Pure IP-PBX
4	Engineer, level 8	15	3	Operating and maintain for Hybrid IP-PBX and Pure IP-PBX
5	Section Manager	10	2	Operating and maintain for Hybrid IP-PBX and Pure IP-PBX
6	Section Manager	15	6	Planning and designing of telephone system Preparing bidding document Cooperate with internal customer
7	Engineer, level 10	10	3	Planning and designing of telephone system Preparing bidding document Cooperate with internal customer

Criteria Selection

Because the criteria serve as the performance measures for the application of any multiple-criteria decision making model, their selection is critical for the decision process. A number of specific considerations need to be taken into account, however, in finalizing the choice of the criteria to be used in the application of AHP model. These include:

Completeness – It is important to ensure that all of the important criteria are included. In this connection, the concept of a hierarchically structured value tree (or a layered diagram) is a valuable tool.

Non-redundancy – In principle, criteria that have been judged relatively unimportant or to be duplicates should be removed at a very early stage. However, omission on these grounds should be approached with care.

Operationality – It is important that each alternative should be meaningful and can be judged against each criterion.

Minimum Number of criteria – An excessive number of criteria leads to extra analytical effort in assessing input data and can make communication of the results of the analysis more difficult. A final check to ensure that the number of criteria is not larger than it needs to be is necessary. Complex issues can be addressed effectively by using a hierarchical structure given the inability of human to compare more than seven categories simultaneously. A hierarchy should not contain more than seven elements. Under this limited condition, a

rational comparison can be made and consistency ensured as well (Keeney and Raiffa, 1976; Goodwin and Wright, 1998).

First Instrument

Criteria involved in the VoIP system evaluation need to be identified with great care. These factors are chosen keeping in mind the organizational needs. For this study, the researcher collected empirical data from several experts within EGAT. Instrument was an in-depth interview (face-to-face interview or interview via telephone) guide. The interviews were held at a location selected by the expert participating. Each interview lasted between 45-60 minutes depending on the availability of the expert. A set of criteria extracted from the literature were first proposed to the experts and discussion was made with the experts. Then, each expert could add any other relevant criteria for themselves or remove insignificant criteria. Each expert had to feel that every criterion covered their domain of technology type evaluation. The discussion involved a set of criteria and a series of open-ended questions about

- What are the frequently-used features of existing telephone system in the company?
- What are the telephone/VoIP features that should be deployed in the company?
- What are the technology types of VoIP experienced with?
- What advantages (pros) of the technology types are experienced with?
- What disadvantages (cons) of the technology types are experienced with?
- What are the set of criteria that covered all the evaluation facet of a technology?

Second Instrument

The parameters identified for evaluating the VoIP system were chosen based on the requirements of the organization, as the first instrument. It would have been very easy to rate the VoIP system if all the parameters were of equal importance, but evidently it is not so. Qualitative criteria may be of major importance followed by others. Hence, it becomes essential to know the relative importance of each factor that has been selected.

The results from the first instrument were used to develop the second research instrument. In order to develop the second instrument, each question from the in-depth interview was analyzed to determine all of the VoIP technologies that any of the experts considered viable. The results were that the experts identified three alternatives of VoIP system and four main criteria.

Once the list of VoIP solution was compiled the second instrument was developed which involved a series of pairwise comparisons between the three alternatives. After the research instrument was developed it was tested on employees at the researcher's workplace. None of the employees had prior knowledge of pairwise comparison and thus, had only the instructions that were provided in the instrument to guide them in answering the questions. The employees' lack of prior knowledge about pairwise comparison provided the opportunity to evaluate how well the experts would understand the Instrument's instructions since none of the experts had used pairwise comparison in the past either. The staffs' comments and suggestions for improvement were incorporated into the instrument and it was re-tested on employees at the researcher's workplace. Additional changes based on their comments were incorporated into the research instrument prior to distribution to experts.

The survey or second instrument conducted was based on the analytic hierarchy process. It involved the pair-wise comparison of factors amongst each other. For this, AHP was first explained to the respondents. The survey questionnaire with a detailed explanation of each factor was filled by the respondent. The selected candidates were briefly explained about AHP and especially the comparison matrix that they were required to fill in. They were given examples in order to give a complete understanding about the new concept. The scale of comparison was chosen between 1 and 9, where 1 stood for equal importance and 9 for extreme preference. This scale was also available for reference of the respondents on the first page of the questionnaire included with this paper.

The questionnaire consisted of comparison matrix for the first level in the hierarchy, i.e., the four major criteria, followed by matrices for the sub- criteria at the second and third level. The first comparison matrix requires all the major criteria to be compared among them. The process continues until all the parameters are compared amongst each other. Thus, the comparisons among the entire hierarchy are carried out. The respondents were required to fill in only the top half of the matrix and the lower half was hence darkened. A period of over one week was given to the respondent to fill in the questionnaire.

These filled questionnaires were used to generate the priorities of the factors for evaluation at the various levels. Each filled matrix was checked for consistency; and if it was found inconsistent, then that respondent was further contacted for a discussion to check the inconsistency. It was seen that most of the cases, the inconsistency was only marginal and it was because AHP was new to the respondents. However, discussions proved very fruitful since the inconsistency could be solved. A sample calculation for this procedure has been incorporated. In this study, Expert Choice software was deployed to compute the weights from the responses. The consistency test was used to calculate the inconsistency ratio (IR) of the adoption criteria. All criteria have received consistent responses as their IR value must less than 0.1 (Saaty, 2001).

RESULTS AND ANALYSIS

This revolves around the provision of VoIP technology for Electricity Generating Authority of Thailand (EGAT). A group of seven experts from the communication system division of EGAT was selected, for the purposes of the selection of VoIP technology. In-depth interview techniques were used to select which criteria would be used by the experts. The experts were chosen for this purpose. The experts were chosen according to their experience with evaluation telephone system in EGAT. Table 1 shows the experts' personal profile. The problem statement resulting from the in-depth interviews was "evaluating and selecting the most appropriate VoIP technology for EGAT". Roughly, they gave some recommendations for the definition derived following problems:

- The alternatives of VoIP technology should be enterprise-level solution.
- The system should be high reliability, availability and security.
- The system should be interoperable with the existing system.
- The cost of the system should be acceptable.
- It should be easy to use and maintenance.
- It was expected to enhance productivity of users.
- It was expected to help operation team to work efficiently.

A list of the evaluation criteria of IT/IS and VoIP was developed from the literature review. The criteria were condensed into a set of 28 criteria shown in Table 2 which were presented to the experts.

Development and Execution of the Model

After performing in-depth interviews on the various issues and criteria with seven experts, the initial criteria were then revised and reduced to 26 criteria. With the overall goal being the 'selecting the most appropriate VoIP technology for EGAT', the 26 criteria were categorized into four first level categories: 'benefit', 'low cost', 'technical feasibility', and 'low risk'. The final hierarchy model used in the AHP experiment is shown in Figure 1 with all the relevant criteria. After further discussion with EGAT experts and the set of criteria established, the seven experts decided that the possible technology choices were the pure IP-PBX, hybrid IP-PBX, and open-source IP-PBX.

The seven experts helped prioritize the criteria. They individually executed the analytic hierarchic process on the model with questionnaire. Individual relative weights were allocated to each criterion after a pairwise comparison. If the inconsistency ratio for all the pairwise comparisons was greater than 0.1 the individual expert went through another iteration of the process. Finally the three technologies were compared pairwise to each of the 26 terminal nodes (leaves).

Structuring the Hierarchy

The goal is to select the most appropriate VoIP technology for EGAT. This goal was placed at the top of the hierarchy. The hierarchy descends from the more general criteria in the second level to subcriteria in the third level to secondary subcriteria in the fourth level to the alternatives at the bottom or fifth level. General criteria level involved four major criteria: benefit, low cost, technical feasibility, low risk.

Intangible benefit and *tangible benefit* were placed under the *benefit* criterion in the third level of the hierarchy. Each of these in turn needed further decomposition into specific items in the fourth level. *Intangible benefit* decomposed into seven criteria: *Enhancing end-user productivity, creating new business opportunities, improvement of cooperation, improving in consumer service, aligning with business strategy, improvement of organizational image, and improvement of voice and data system management. Tangible benefit* decomposed into three criteria: *Moves/Adds/Changes cost saving, reduce travel cost to remote sites, and fewer support staff required.* We also located *low start-up cost, low on-going operating and maintenance cost, and low conversion cost* under *low cost.* The seven subcriteria were included for *technical feasibility* in the third level. These are *ease of use/friendliness, ease of implementation /management /maintenance, full suite of communications features & business-enabling applications, multi-vendor interoperability, easy scalability, equivalent voice quality to TDM,* and *high system reliability/availability/security.* Six criteria were also included for *low risk.* These are *enough appropriate skills, low technical infrastructure risk, low trade-off risk, low functional risk, low support risk,* and *low risk of technological changes.*

The decision-making team considered three VoIP technologies for the decision alternatives, and located them on the bottom level of the hierarchy. These are hybrid IP-PBX, pure IP-PBX, and open-source IP-PBX.

Performing Pairwise Comparison

After constructing the hierarchy, pairwise comparisons were systematically performed to include all the combinations of relationships of criteria, subcriteria, secondary subcriteria, secondary subcriteria, and alternatives. The criteria and subcriteria are then compared according to their relative importance with respect to the parent element in the adjacent upper level. Due to the differences among the schedule of the experts and managers, questionnaires including all possible pairwise comparison combinations were distributed to the decision makers.

The pairwise comparison matrix of the criteria and sub-criteria is used to obtain each hierarchical factor weight, in which the eigenvector. After performing all pairwise comparisons by the decision-makers, individual judgments were aggregated using the geometric mean as suggested by Saaty (1990).

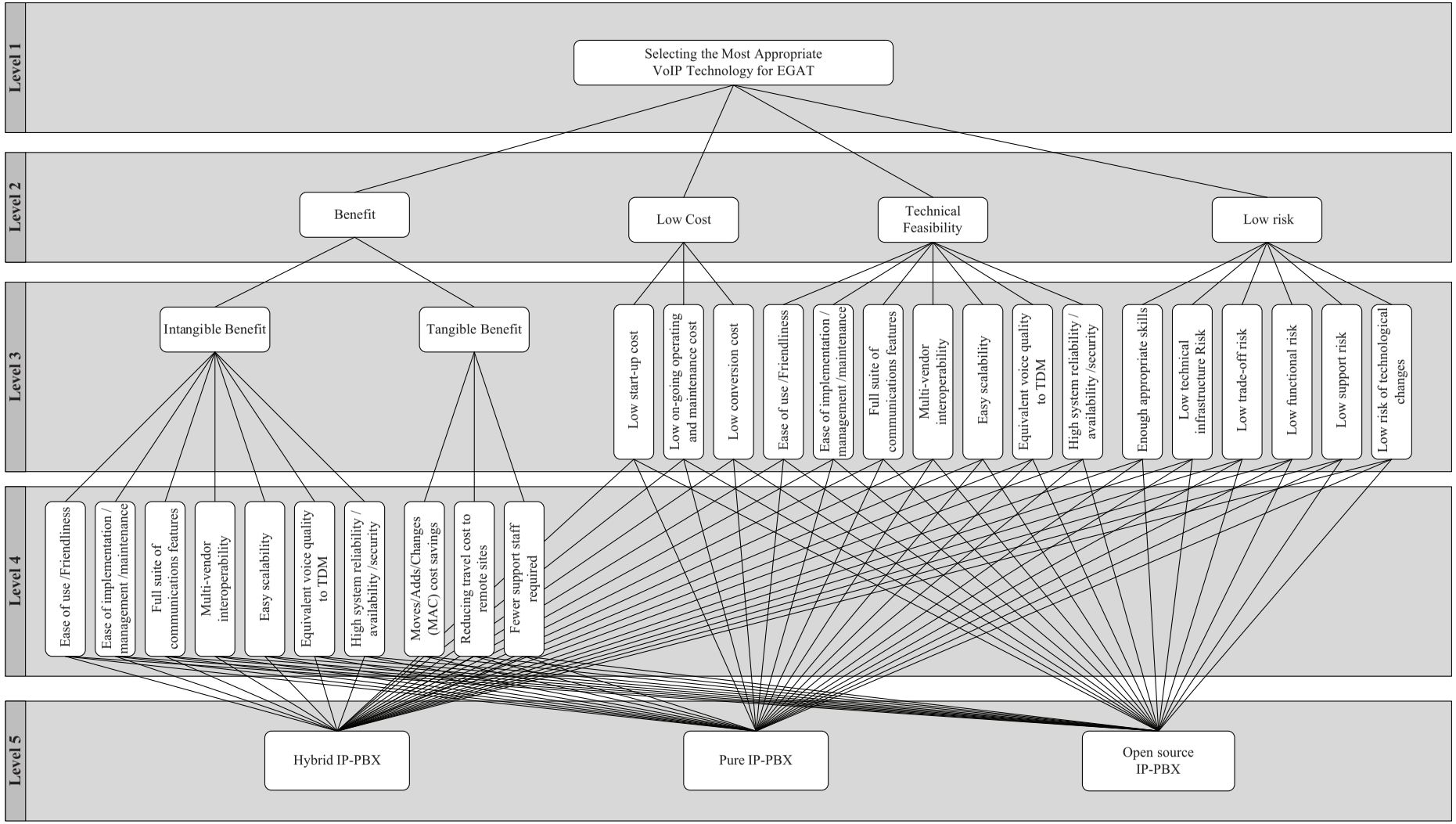

Figure 1 A hierarchical representation of selecting the most appropriate VoIP technology

Table 2 Criteria of AHP model and their definition

Criteria	Definition	References
Level 1 Goal	Selecting the Most Appropriate VoIP Technology for EGAT	
Level 2 criteria		
Benefit	The degree to which EGAT will gain benefit from new tehcnology after deploying VoIP.	Escobar-Perez (1998), Bacon (1992), Walker and Hicks (2004)
Low cost	The degree to which EGAT will payfor the cost to implement new technology.	Jones and Beatty (1998), Iacovou et al. (1995), O'Callaghan et al. (1992)
Technical feasibility	The degree to which new technology meet technical requirement of EGAT environment.	Jones and Beatty (1998), Catchpole, Middleton and Nelson (2001), Pierce (2007), Walker and Hicks (2004), Hoover (2006)
Low risk	The degree to which VoIP will not degrade business process, operation, and customer satisfaction .	Catchpole, Middleton & Nelson (2001), Pierce (2007), Walker and Hicks (2004), Hoover (2006)
Level 3 Benefit subcriteria		
Intangible benefit	It assesses the degree to which new technology will provide potential to affect the technological leap in the future. However, this intangible benefit is hard and complex to calculate amount of money.	Escobar-Perez (1998), Bacon (1992), Walker and Hicks (2004)
Tangible benefit	It assesses the degree to which new technology will provide clearly defined cost savings.	Escobar-Perez (1998), Bacon (1992), Walker and Hicks (2004)

S3-10

Table 2 Criteria of AHP model and their definition (continued)

Criteria	Definition	References
Level 3 Low cost subcriteria		
Low conversion cost	They represent the amount paid to adapt the existing telephone system to the new one. This amount may be considered as the sum total of software and/or configuration and equipment expenses. A VoIP technology with low cost is a better alternative.	Jones and Beatty (1998), Irani (2002), Mirani and Lederer (1998), Banerjee and Golhar (1994), Iacovou et al. (1995)
Low on-going operating and maintenance cost	They represent the amount paid for permanent maintenance, materials and the necessary communication system infrastructure. A VoIP technology with low cost is a better alternative.	O'Callaghan et al. (1992), Walker and Hicks (2004), Gareiss (2005)
Level 3 Technical feasibility subcriteria		
Ease of implementation /management /maintenance	It assesses the degree to which new technology is easy to implementation, management and maintenance. If management of the IP telephony solution is not straightforward and intuitive, it will take a long time to operate the system.	Jones and Beatty (1998), Catchpole, Middleton & Nelson (2001), Pierce (2007),
Ease of use/ Friendliness	It assesses the degree to which new technology is easy to use. The IP phones and call control software should be intuitive and easier to use than the analog phones being replaced. Features like on-the-fly conference calling, drag-and-drop call transferring, and the forwarding of voice mail messages via e-mail should be simple for employees. The commands should be understandable and non-ambiguous commands: syntax clarity and semantic concision of commands accessible to users.	Walker and Hicks (2004), Hoover (2006)
Easy scalability	It assesses the degree to which new technology has capability to scale the system for specific needs of EGAT such ng and shrinking number of users during different times of the yea or in some other cyclical manner.	

S3-11

Table 2 Criteria of AHP model and their definition (continued)

Criteria	Definition	References
Multi-vendor interoperability	It assesses the degree to which new technology has capability to interoperate with the existing system and also other vendors.	Jones and Beatty (1998),
Equivalent voice quality to TDM	It assesses the degree to which new technology has the same quality as the traditional or TDM system.	Catchpole, Middleton & Nelson (2001), Pierce (2007),
High system reliability /availability /security	It assesses the degree to which new technology include mechanism supporting reliability /availability /security of telephone system such as redundant components in the case of a failure and the ways to reroute calls around a failed switch.	Walker and Hicks (2004), Hoover (2006)
Full suite of communications features & business-enabling applications	It assesses the degree to which new technology has value-added services that meet the majority of EGAT requirements.	Escobar-Perez (1998), Bacon (1992)
Level 3 Low risk subcriteria		
Enough appropriated skills	A skill set of new technology will be required for successful integration.	Irani (2002), Iacovou et al. (1995)
Low functional risk	The possibility that the VoIP does not fulfill the project's requirements. A VoIP technology with low risk is a better alternative.	Catchpole, Middleton & Nelson (2001), Pierce (2007),
Low risk of technological changes	The possibility that the use of the technological pattern adopted is discontinued in a near future. A VoIP technology with low risk is the a alternative.	Walker and Hicks (2004), Hoover (2006)
Low support risk	The possibility of interrupting product support. A VoIP technology with low risk is the a alternative.	Catchpole, Middleton, & Nelson (2001), Pierce (2007),
Low technical infrastructure Risk	This assesses the degree to which extra investment, outside the specific project, may be necessary to undertake the project. A VoIP technology with low risk is a better alternative.	Walker and Hicks (2004), Hoover (2006)
Low trade-off risk	The possibility that the adoption of a given VoIP solution might block or	

S3-12

Table 2 Criteria of AHP model and their definition (continued)

Criteria	Definition	References
	trouble the future adoption of another. A VoIP technology with low risk is the a alternative.	
Level 4 Benefit/intangible tertiary subcriteria		
Enhancing end-user productivity	It asseses the degree to which IT/IS projects enhance end-user productivity. Identification of productivity changes caused by IT.	Jones and Beatty (1998), Kaplan (1986), Ryan and Harrison (2000)
Creating new business opportunities	It asseses the degree to which IT/IS projects create new business opportunities.	Jones and Beatty (1998), Irani (2002),
Improvement of cooperation	It aims at checking whether the IT encourages cooperative work among the people involved.	Mirani and Lederer (1998), Banerjee and Golhar (1994), Iacovou et al. (1995),
Improving in consumer service	It asseses changes associated with the IT which positively influence the relationship with clients.	Walker and Hicks (2004)
Aligning with business strategy	It asseses level to which the IT supports the strategy of the business.	Escobar-Perez (1998), Bacon (1992), Mirani and Lederer (1998), Walker and Hicks (2004)
Improvement of organizational image	It measures how the IT use will positively influence the image of the organization from the clients' point-of-v	
Improvement of voice and data system management	Central management of IP and PBX boundaries will be necessary for a successful model. The Voice Services group will need to use centralized tools to monitor IP- capable systems in addition to traditional PBXs. Monitoring can partially be integrated into some existing tools of EGAT such as HPOV (Hewlett Packard Open View) for Call Servers, distributors and gateways.	Irani (2002), Orli and Tom, 1987, Banerjee and Golhar (1994), Walker & Hicks (2004)Ryan and Harrison (2000), Irani (2002)

S3-13

Table 2 Criteria of AHP model and their definition (continued)

Criteria	Definition	References
Level 4 Benefit/tangible tertiary subcriteria		
Moves/Adds/Changes (MAC) cost savings	Moving an IP telephone station temporarily or permanently or adding a new user usually simply entails carrying out a quick and simple GUI-based command. Companies save on MAC activities, depending on the company size and number of MACs per year.	Jones and Beatty (1998), Irani (2002),
Reduce travel cost to remote sites	Employee can use viedeo conference to have a meeting instead of travel to any remote site. They can save a lot of time. Company can save a lot of allowance for traveling, house, food, and others.	Mirani and Lederer (1998), Banerjee and Golhar (1994), Iacovou et al. (1995), O'Callaghan et al. (1992),
Fewer support staff required	With VoIP, management savings are usually immediate since the information technology team can support the voice network as well as the data network because they're now one in the same. There is no longer a need to have two teams of technical professionals to handle each entity which adds up to tremendous savings.	Walker & Hicks (2004), Gareiss, R. (2005)

Synthesizing the Results

The experts were asked to compare each pair of alternative with respect to each of the main criteria in Level 2, each sub-criterion in Level 3, each secondary sub-criterion in Level 4 and each secondary sub criterion in Level 5.

In this study, the so-called "ideal mode" would be the way to synthesize the results since the decision is to find the one best alternative. After deriving the local priorities for the criteria and the alternatives through pairwise comparisons, the priorities of the criteria are synthesized to calculate the overall priorities for the decision alternatives. *Pure IP-PBX* turns out to be the most preferred supplier among the three alternatives, with an overall priority score of 0.411.

Sensitivity Analysis

One of the advantages of the AHP process is that one could test the sensitivity of the final choice to retrospective changes in the assessment of a criterion or parts of the model. A series of sensitivity analyses were conducted to investigate the impact of changing the priority of the criteria on the VoIP technologies' rank. *Performance* sensitivity analysis of *Expert Choice* was performed. *The Performance graph* displays how the alternatives perform with respect to all objectives as well as overall.

The sensitivity analysis of four main criteria is shown in Figure 2. In terms of the *benefit, low cost,* and *technical feasibility* criteria, the overall results indicate that *pure IP-PBX* appears superior to the other alternatives whereas *hybrid IP-PBX* appears superior to *open source IP-PBX*. The results of the sensitivity analyses indicated that when the importance of the *benefit, low cost,* and *technical feasibility* criteria were changed, the VoIP technologies' ranking do not change for all priorities. As shown in Figure 3, however, the decision will change when the importance of the *low risk* criterion was increased more than 0.58, then the *hybrid IP-PBX* will be superior to *pure IP-PBX.*

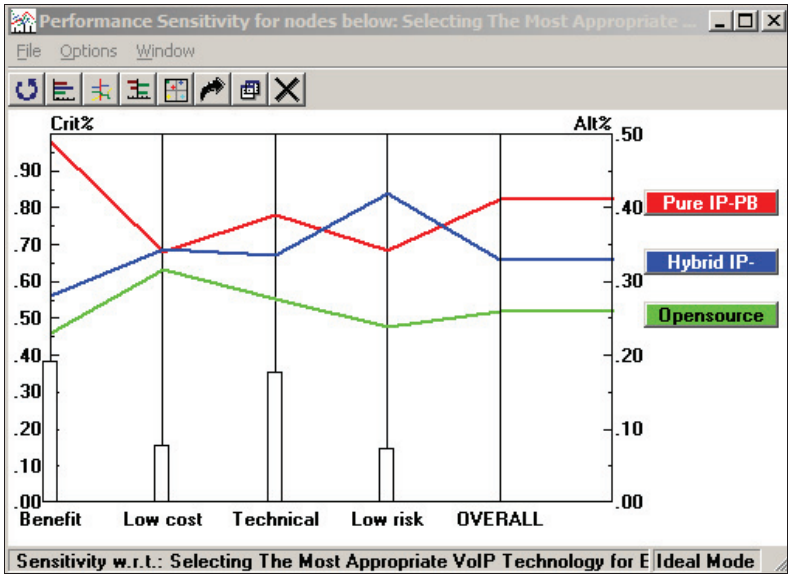

Figure 2 Performance sensitivity graph shows the priorities of the alternatives of VoIP technology for m
ain criteria as well as overall with respect to goal.

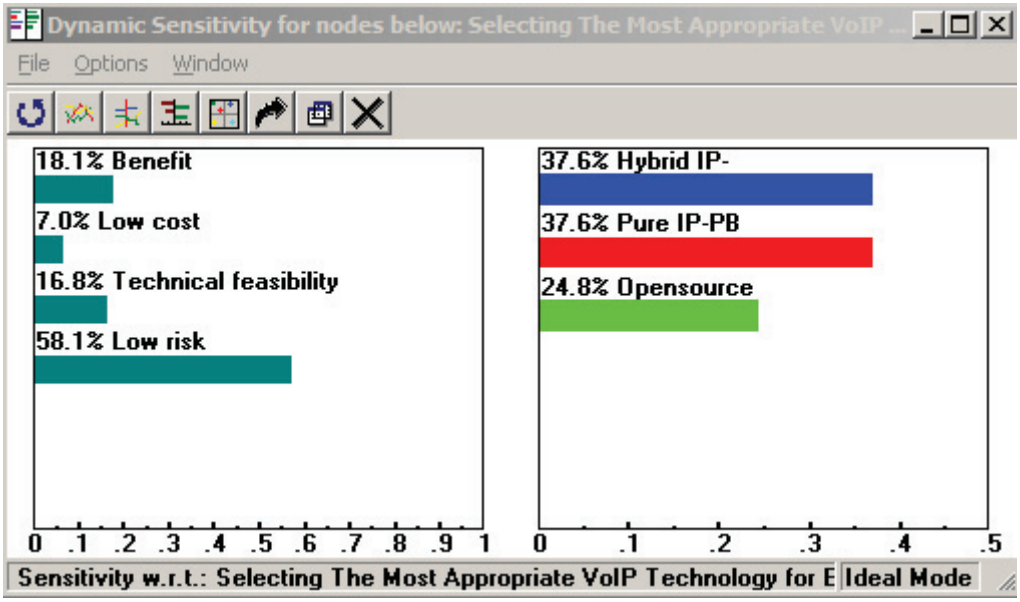

Figure 3 Dynamic sensitivity graph shows the priorities of the alternatives of VoIP technology for 58.1% priority of *low risk criterion* with respect to *goal* at a time.

DISCUSSION AND CONCLUSION

When EGAT is confronted with choosing the best technology to deliver a good or service, the decision can often be very complex. Technology selection problems are multi-objective problems which have many qualitative and quantitative concerns. Decision-makers needed a methodology well supported with a well developed-software conducive to real life applications that is easily understandable by the managers.

The methodology of this research applied decision process of Simon (1977) to obtain the most appropriate VoIP technology for EGAT. First, in-depth interviews were conducted to discuss about problem identification, evaluation criteria and alternatives. Second, the validated list of criteria from literature review and alternatives were revised. Third, the revised criteria and alternatives were used to establish AHP model.

The goal of AHP model was *"Selecting the most appropriate VoIP technology"*. The main criteria were *"benefit"*, *"low cost"*, *"technical feasibility"* and *"low risk"*. Those main criteria were decomposed into 26 subcriteria. Seven experts then performed pairwise comparison of AHP model via questionnaires. The individual results of pairwise comparison were checked for consistency. If the results were inconsistent, then experts would have asked to revise the comparison again. Actual process of conducting this analysis helped the decision making team prioritize the criteria in a manner that otherwise might not be possible. The team was far more confident with their decision since this study showed them even if the importance of certain criteria changes overall ranking does not change though the degree of preference rating is strengthened or weakened. Bounded rationality and limited cognitive

processes make it really impossible for the decision maker to adequately consider all of the factors involved in a complex screening decision. Without decision support methodologies like AHP, managers might base their decisions on only a subset of important criteria while not understanding their relative importance and interactions. After that, the results of every expert were combined and also checked for inconsistency.

With its commercial software, AHP enables sensitivity analysis of the results which is very useful in practical decision making. This study performed sensitivity analysis to see how robust the final outcome was. It was found that no matter how much we increase or decrease the priorities of three main criteria (*benefit, low cost* and *technical feasibility*) and their subcriteria, the overall rank of the outcome was preserved although these experiments changed the magnitudes of the superiority of the best alternative. However, sensitivity analysis indicated that outcome is sensitive to the changes in the importance of *"low risk"* criterion. The highest rank of the alternatives was going to change from *pure IP-PBX* to *hybrid IP-PBX* when the importance rating of *"low risk"* changed from .137 to .581.

It can be concluded that *pure IP-PBX* is the most appropriate VoIP technology for EGAT with respect to overall priority of four main criteria. This result was rather insensitive to the changes in the importance of each main criterion.

In the actual situation of EGAT, the management team considered mainly tangible and financial factors including return of investment. They were confident to make decision based on those factors. They simply select the most appropriate alternatives by comparing capital cost and operation cost of each solution. The results of this study also support this judgment. Table 4 shows that *hybrid* IP-PBX receives the highest priority with respect to *low cost* criteria. However, this study considers not only tangible factors but also intangible factors such as intangible benefit, risk, ease of maintenance, ease of use and etc. It uses AHP as a decision tool to combine both tangible and intangible factors. The highest rank of VoIP alternatives was changed from *hybrid* IP-PBX to *pure* IP-PBX.

With VoIP technology selection problem, EGAT has to confront with several alternatives and various decision factors. Without the decision tool, management team can only decide based on tangible factors. This decision may have negative impact to maintenance team and EGAT users. If the selected choice is difficult to maintain and use, the operational cost will unexpectedly increase. Technology acceptance of maintenance team and users were low. This perhaps led to low productivity of EGAT. AHP can help EGAT to select the most appropriate choice. The decision team of EGAT can consider both tangible and intangible factors by merging the result of each pairwise comparison into AHP software. AHP can be used as a decision tool to combine every significant factor. A group of selected experts were then invited to make pairwise comparisons on alternatives with respect to criteria and sub-criteria. AHP software will combine the judgment of each expert automatically and then compute the priority and rank of every alternative. Then, the best alternative with highest priority was selected.

Although AHP methodology is quite complex and requires much effort to create questionnaires, it provides the sensitivity analysis which is very important for practical decision making, sometimes even as important as finding out the best solution. It must be stressed that any decision making technology serves as an enhancement to human judgement

by, among other things, conflicting criteria and the subjectivity of the individual decision makers towards an acceptable consensus decision. Moreover, the functions and features of each VoIP alternative are changing annually. These changes influence decisions of the experts. AHP would be refined with new information, experience, increasing the accuracy of and the time taken to make the most appropriate choice of VoIP technologies. Therefore, it is suggested that an AHP decision making template be developed for the selection of VoIP technologies that would be regularly updated and improved. To implement AHP in EGAT seamlessly, management team should push AHP into policy and encourage decision makers to apply it in a real scenario.

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THE TACIT SIGNAL E-HRM METHOD AT ORGANIZATION PERFORMANCE DEVELOPMENT

Marko Kesti and Antti Syväjärvi University of Lapland, Finland
marko.kesti@mcompetence.com, antti.syvajarvi@ulapland.fi

ABSTRACT

Article describes new tacit signal measurement as a function of employee performance and productivity development. Tacit signals are personal, circumstances and item connected guiding beliefs that arise from emotional and tacit knowledge which are usually difficult to express by words. Tacit signal competence measurement gives new information about organization development. Article describes also new mental model of five interrelated competences for understanding organization development pluralistic nature.

By measuring and analyzing tacit signals in real time the optimal improvement actions can be started in short notice. Systematic and effective work practices development increase organization productivity which is showed by large business company case study in three years empirically grounded research. Systematic employee performance development using tacit signal method has shown to be effective in improving organization productivity.

Tacit signals together with systematic development services enable whole organization development. This is important since the majority of the groups need tools and expertise to succeed in their work practices improvement. Weakest performing groups produce the majority and are therefore the most potential in profitability improvement. It seems that with effective e-HRM tools and practical development the organization can successfully implement profitable growth strategy.

Keywords: innovation management, performance management, competence management, organization development, productivity, e-HRM.

INTRODUCTION

The internal and external environment of organizations is changing continuously, which causes challenges for the human competence development and management. Most of the quality costs forms from poor work practices causing lost labor (Andersson et al., 2004). Hence continuous development is crucial for maintaining competitive advantages. However many managers don't understand the nature and potential of work organization development (Alasoini et al., 1997). Improving organization operations is complicated because development should be based on tacit knowledge of humans in social environments. Organizations need conceptual understanding and practical tools to analyse, plan and implement the change process (Alasoini et al., 1997). Hence, an obvious need for developing the organizational information systems (e.g. Beynon-Davies, 2002) exists especially in the area of human resources.

In the case of humans and competitive advantages, the organizations want to improve their human competence recognition and management. Usually, the human competence is found so difficult and complex that the recognition or development cannot be easily done. In addition, the traditional methods are repeatedly too expensive, slow or otherwise complicated for

achieving continuous performance improvement. This article will demonstrate tacit signal method as an effective e-HRM system for utilizing tacit knowledge in organizations. The tacit signals refer to personal beliefs concerning the improvement needs of human competencies (rf. Stone, 2002; Kesti, 2005), but also to a fundamental element of effective leadership.

New tacit signal based e-HRM system is introduced as a human resource information system (HRIS) (Kesti et al., 2008). An information system itself can be seen as physical process that supports organization by providing critical information to achieve goals (Syväjärvi & Stenvall, 2006). The current e-HRM serves as a fluent, accurate and fast responding human resource information system. The current human resource information system is seen as a support for effective leadership and performance management. This allows leaders to accomplish productivity improvement actions across the working community based on the collective tacit knowledge. By tacit signal e-HRM it is possible to relate the human competence success factors with a positive spiral and thus to minimize the risk of low human competence utilization. New tacit signal e-HRM method seems to recognize and develop the intangible assets quite optimally and fast. It seems that measured tacit signal competence correlates with the working society performance and therefore supports organization performance management and productivity improvement.

Jack Welch has divided employees to three categories in terms of performance: top 20 %, middle 70 % and bottom 10 % (Welch & Welch, 2005). Our observation is that that there seems to be two general obstacles preventing organization performance improvement. Normally only 20 % of organization groups succeed in developing their work practices and 80 % are not able to develop by themselves. Furthermore the limited development time is misused so that 80 % of that time is used at not constructive defensive mechanisms and only 20 % to solving problems. When both these rules apply, the organization can not improve productivity. This phenomen is extremely crucial for labour-intensive organizations in private and public sector. Effective development methods with proper e-HRM tools should enable to convert these obstacles to great possibilities to improve organization performance and productivity.

BACKGROUND

In modern society the economical meaning of knowledge base and intangible assets has exceeded the material capital, natural resources and work force (Drucker, 1993). To succeed the organisation should have process where each person and group can reflect knowledge and experiences and so improve the contribution to the organization objectives (Argyris & Schon, 1978). Several research studies show that organisations which are committed to the employees and let the tacit knowledge base increase are the most successful in longer term (Arie de Geus, 1997; Ylöstalo, 2005; Collins & Porras, 1994). Some business areas the intangible assets managing is the most important issue in creating the competitive advantage (Porter, 1985). Therefore the human intangible assets should be one of the most important development items in the organisation. These human success factors or competences are intangible drivers of performance which are the most difficult to identify and develop.

The management has important role in identifying the performance drivers and investing in the development. The most crucial thing is the top management ability to build visionary and

inspiring mission for the organisation, so that everybody are struggling along to the same direction (Collins & Porras, 1994). Top management, leaders and workforce all have crucial elements for the organisation performance and success. As in a car you can't say which part is the most important thing the steering wheel, the tires or the motor.

Human being is naturally social and in the interdependency the learning is the most effective and natural phenomenon (Vygotsky, 1978). In the organisation the knowledge forms from collective learning and sharing of information (Prahalad & Hamel, 1990). Knowledge can be divided to explicit and tacit knowledge. Explicit knowledge is rational and can be described and visualised by documents and pictures (Nonaka & Takeuchi, 1995). Tacit knowledge is experience based knowledge that is difficult or impossible to document or describe by words (Nonaka & Takeuchi, 1995). Tacit knowledge is highly personal emotion and feeling based and therefore difficult to express. Nonaka and Takeuchi (1995) describe the new knowledge creation with interactive social process between explicit and tacit knowledge. Tacit knowledge has to be formulated to words or documents so that it can be further converted to explicit knowledge which creates again new tacit knowledge. Social intercommunication like dialogue, discussion and observation speeds up the knowledge creation process and activates organisation learning.

It has been shown that the best performance or optimal cognitive efficiency is achieved at optimum stress level (Goleman, 2006). Certain creative stress or tension is needed to get things done. When the optimal stress level is exceeded the performance will drop down as the harmful stress level increases (Abercrombie et al., 2003). This tension-performance phenomen is called inverted U-curve and was introduced by Yerkes and Dodson (Yerkes & Dodson, 1908) and is known by Yerkes-Dodson law. Goleman (2006) points out that stressed people become defensive and too high stress hormone levels causes mistakes and disables learning new things. A sense of safety creates good base for learning and some tension is needed to keep on the motivation (Goleman et al., 2002).

It seems that there are certain performance drivers which can be recognised as organization competences. As employees are best experts of their own work and working society, they have tacit knowledge based feelings about the development needs. If these personal feelings could be measured for each crucial competence using inverted U-curve principle, it could be possible to do the right corrective actions to improve the competence. As inverted U-curve correlates with the performance the measurement should have the same feature. Tacit signal method appears to have these qualities.

If organization can keep competences at good condition when facing new challenges, it can also maintain good business performance. This balance between creative tension and competence development is important for organization continuous improvement. Senge (2006) points out that goal setting and balancing feedback must go together in balance to perform goal oriented operation (Senge, 2006). If balancing feedback is blocked it will complicate strategy implementation. Tacit signals e-HRM system support managers and leaders to make right decisions to improve the performance driver back to optimal balance.

THE TACIT SIGNAL PRINCIPLE

Tacit signals are personal beliefs and ideas relating to improvement needs of human competencies. When the organisation is influencing those beliefs the competence factor can be developed more consistent with the goals of the organization. Tacit signals are personal, circumstances and item connected guiding beliefs that arise from emotional and tacit knowledge which are usually difficult to express by words. Measuring and analyzing tacit signals in real time the optimal improvement actions can be started proactively.

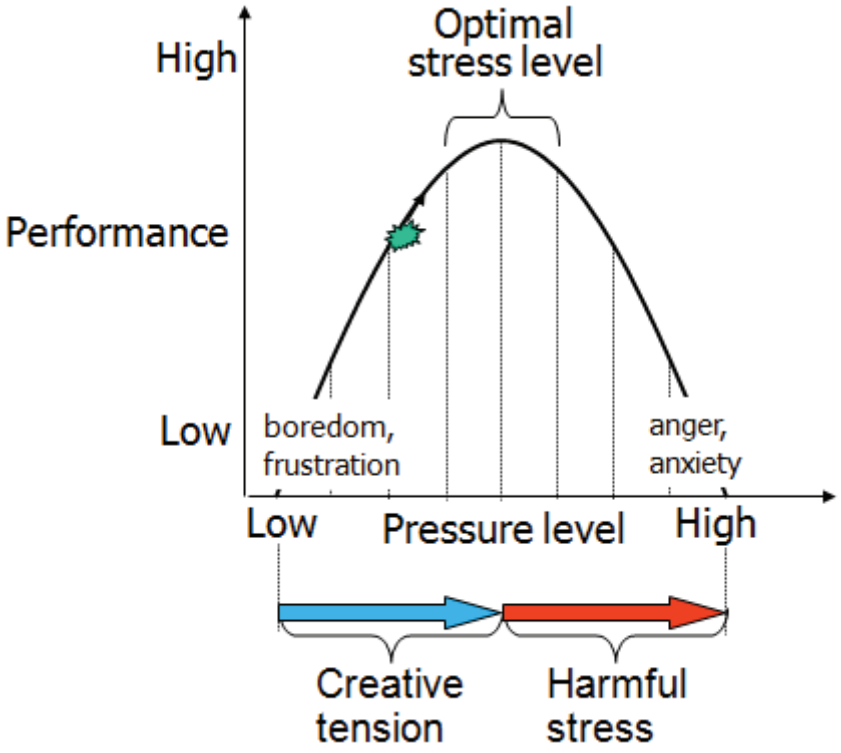

Figure 1. Tacit signal principle in performance stress curve (inverted U-curve).

Tacit signal method fits well to the phenomen of inverted U-curve. Figure 1 shows the principle of how tacit signal shows if there is balance or unbalance at the chosen performance driver or competence. Measured competence can be linked to the scorecards like internal and external quality costs, work absence, disembarkation rate and profitability. Therefore measuring tacit signals fits well for the Balanced Scorecard measures for the learning and growth perspective (Kaplan & Norton, 1996).
The main idea in measuring the tacit signals is to increase the innovativeness and profitability through better management and the development of the whole organization. It improves the organization's ability to prioritize the development actions of competencies and do improvements effectively.

TACIT SIGNAL MEASUREMENT

The principle of interrelated and opposing factors affecting at organization is raised in the Nonaka and Takeuchi book The Knowledge Creating Company. They have observed that there are multitude dichotomies – such as tacit vs. explicit, mind vs. body (or matter), self vs.

others – are affecting on organization knowledge creation. These dichotomies are not different coins but rather the opposite sides of the coin being mutually complementary (Nonaka & Takeuchi, 1995). At our research from several organizations we have noticed that optimal condition for organization development exists when two affecting complementary sides are in harmony. Furthermore the development need is determined based on the side the unbalance occurs. This approach of two opposing interrelated forces guiding to correct the organism back to harmony is also visible at oriental philosophy of yin and yang (Xinnong, 1999). Same phenomen is visible at the Yerkes-Dodson law of tension-performance relation, which is important basis of human performance and emotional intelligence development (inverted U-curve) (Yerkes & Dodson, 1908).
Kaplan and Norton has pointed out that the balanced scorecard has been lacking good company specific measures for the learning and growth perspective. They note that absence of specific measures indicates that the company is not linking its strategic objectives to activities for re-skilling employees, supplying information, and aligning individuals, teams and organizational units to the company's strategy and objectives (Kaplan & Norton, 1996). Tacit Signals e-HRM system makes possible to measure and analyze tacit signals in real time. Measuring is based on a dichotomy scale self-assessment and the analyzing is done using competence potential vectors.

Specified Tacit signals measuring tool consist of following measuring principles:
The specified human competence measurement has several competence attributes which are evaluated by dichotomy scale of guiding forces to help improvement decision making. Tacit signals are inquired systematically for specified human driver of performance (competence). Tacit signal opinion includes the guiding factor and possible informal comments for each question. Employee individual answers are under the influence of their personal tacit knowledge which are highly respected by privacy in Tacit signals e-HRM-system. The guiding forces are to be chosen so that it meets the dichotomy principle of two interrelated and opposite forces like rational vs. emotional or quantitative vs. qualitative. One force is guiding to more straightforward actions and the other is more related to emotions needing usually a dialog between the parties and individuals to be improved. Dichotomy improvement semicircle (see figure) adapts to the size of the group so that every individual tacit signal vector can be summed, showing the collective development need and competence (Kesti, Stenvall & Syväjärvi, 2008).

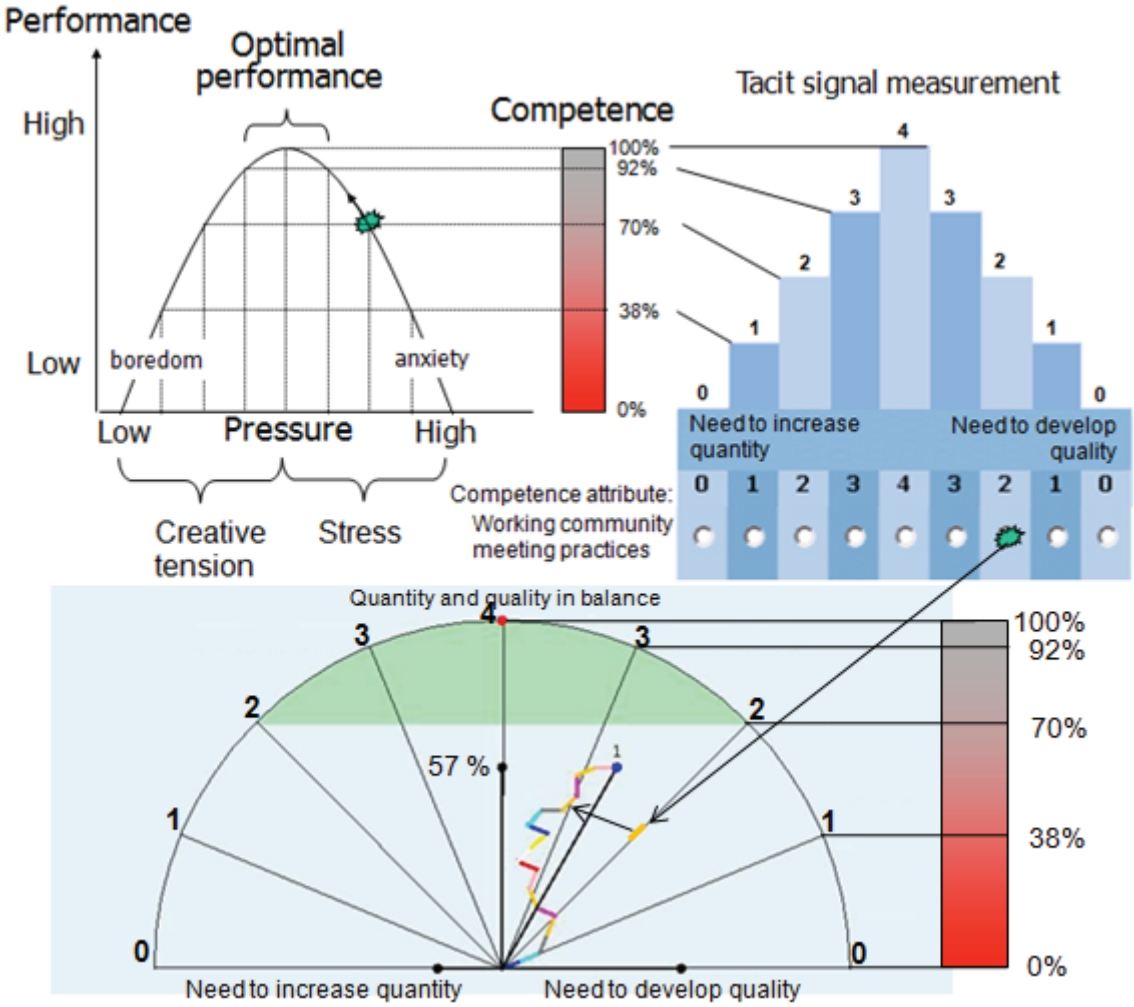

Figure 2. Tacit signal dichotomy scale relation to the inverted U-curve.

Tacit signal measures the development need with the direction to improve the competence. The development is needed if the two interrelated guiding forces are not in balance. The measured improvement focus is on the side where the unbalance is. In the figure 2 the group's (17 persons) collective competence is 57 % against the measured competence attribute: working community meeting practices and the development need is on quality side.

TACIT SIGNAL CONNECTION TO ORGANIZATION COMPETENCES

Nokaka and Takeuchi (1995) points out that each employee is knowledge worker having important tacit knowledge about the organization operations and own work. Individual has skills, knowledge and energy that we try benefit in achieving our aims. Human drivers of performance are the known competence factors contributing the organization to improve productivity and achieving the target.

Each human driver of performance is build from participating individual competence potential. Competence potential has a direction which shows how much of the competence potential is utilized. In this specification the potential can be shown as a vector where the part leading towards the target is the competence (see figure 3).

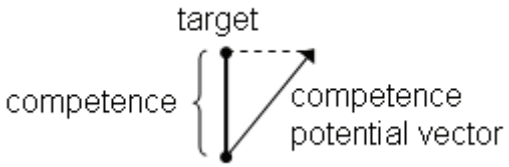

Figure 3. Competence vector principle.

Organization is complex human intelligence system where different competences are interrelated to each other. We have studied organization system intelligence by using the ancient mental model of interrelated five elements. In system intelligence model the five elements are the main competences which seem to be the most important intangible drivers of performance.

One general management definition by Henry Fayol specifies five management areas which are planning, organizing, directing, coordinating and controlling (Fayol, 1949). Drucker (1977) points out successful management areas so that among target setting management requires organizing, motivating, communication, measuring and employee development (Drucker, 1977). Bartlett and Ghoshal (1995) point out that top management first activity is to create attractive meaning for the organization. Mission clarifies the organization direction for development and so it makes easier for the middle managers or leaders to agree and execute the concrete operative actions.

Schein (1985) says that one of the management most important tasks is to strengthen the organization culture. Manager must ensure that the work community can develop and positively adapt to the continuous change of business circumstances. Good manager and leader observe the weak signals and when needed starts collective discussion and co-operation to develop the organization knowledge base, products, processes and tools. The strategically relevant competence is never certain, but rather exists in the form of beliefs which are inconsistent or even contradictory (Sanches & Heene, 1997).

Competences are situation sensitive and therefore constantly changing as organization internal and outside environment changes. Study has shown that for example high employee turnover rate decrease the collective competences (leadership and group culture). This is logical as the competence needs to be updated to meet the new challenges. Therefore competence development is needed to stabilize organization performance to new level. This is referring to the balancing feedback (Senge, 2006) that is needed for organization development. However the organization development is not so straight forward since competences seems to affect each other. For example individual skills are important but do not guarantee organizational learning (Senge, 20006). Group culture affects to the motivation in sharing and adapting information. To make organization learning possible the competences relation to each other must be recognized.

Organization system intelligence model can be built from five important competences: management, leadership, group culture, personal skills and processes (Kesti, 2007). Each competence has several attributes that illustrates the human success factors which should be in good condition for optimal organization development which forms positive spiral (see figure 4). Leadership and culture are collective competences that consists similar competence attributes for each working society. It seems possible to measure these attributes by tacit signal method.

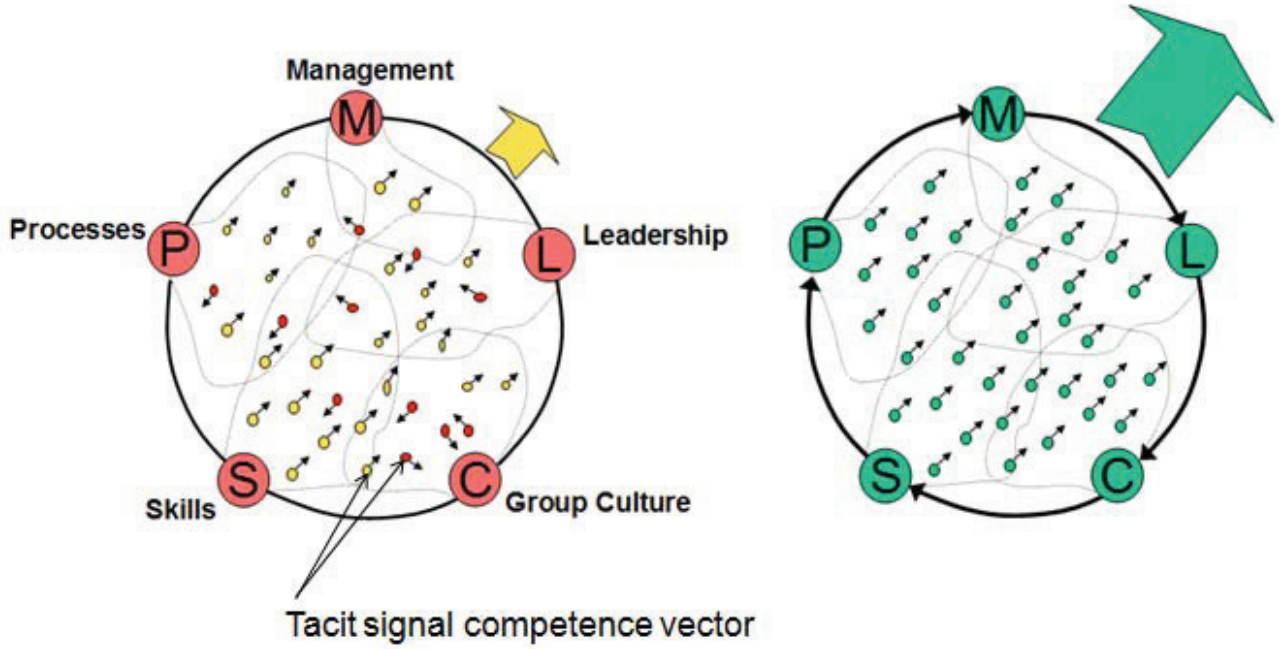

Figure 4. Organization system intelligence consisting five competence areas affecting to each other. (Kesti, 2007)

Tacit signal balance shows if the attribute needs reinforcement or development. Unbalance in reinforcement side means that the attribute is not strong enough to form a positive spiral and therefore needs more activating. Unbalance at quality development side means that the attribute affects negatively to the system. This needs changing the harmful habits and therefore quality side development is more difficult and critical for the organization future. For the organization development as a system it is important to solve the problems but also to strengthen the competence attributes that has positive influence and so contributes the positive spiral. Seeing and analyzing the organization as a system with interrelated competences the organization can be developed optimally and with increased profit earning capacity.

The specified tacit signals e-HRM system consists of following measuring principles:

1. The specified human competence measurement has several competence attributes which are evaluated by dichotomy scale of guiding forces to help competence improvement decision making.
2. Tacit signals are inquired systematically from each working community for specified competences (performance drivers, intangible assets). Opinion includes the guiding factor and possible informal comments for each competence attribute.

The guiding forces are to be chosen so that it meets the dichotomy principle of two interrelated and opposite forces like increase quantity vs. develop quality. One force is guiding to more straightforward actions and the other is more related to emotions needing usually a dialog between the parties and individuals to be improved and understood.

Managers and leaders participation to the development process planning is essential prior to the tacit signal method implementation. Knowledge creation process includes always that the results are gone through at each group after the management review. At the management

review the whole organization is analyzed at strategic point of view by using the system intelligence model. After that each working community goes through their own results with discussions and prioritizing the corrective actions.
Our empirically grounded research has shown the effectiveness of tacit signal method in organization knowledge creation process. The group is able to share the knowledge and agree optimal improvement actions within couple of weeks. In this development process each employee spends about half an hour answering to tacit signal query and 2 to 3 hours at the group meeting. It seems that the tacit signal e-HRM system speeds up the knowledge creation process significantly. The group can agree the corrective and optimal actions with the leader in productive way.

It seems that tacit signal query activates to give written comments and those comments are usually constructive. Our empirically grounded research shows that group is committed to the actions when they are participating to the action idea generation group meeting. Meeting is highly effective because measurement results leads to constructive discussion and concrete development. This beneficial brainstorming increases the group collaboration and self-esteem. Group can innovate corrective actions and prioritize the most important. Agreed actions are followed by electronic group diary and supported by group meetings later on.

RESULTS IN ORGANIZATION PRODUCTIVITY IMPROVEMENT

Case results are based on empirically grounded research at large company (1000 employees) for three years period. Leadership and group culture competences were measured once a year at each 20 business units. Competence development process was done systematically at every unit. As a result of this development the work practices were improved by practical innovations based on group's tacit knowledge (e.g. meeting practices). Business unit's employee productivity was calculated by summing up the HCROI and personnel increase percentages.

Our studies in this large company indicate that in three years period the tacit signal development process has improved company productivity significantly. Measured leadership and culture competences correlation with organization employee productivity was slightly over 25 % (see figure 5). This is understandable since there are also plenty of other important factors like strategy and market situation which are affecting to organization business performance. HCROI (Human Capital Return On Investment) is index that comes from sales margin divided by staff costs (Fitz-enz, 2000). Employing new staff is investment that at least in short term reduces profitability and therefore profitable growth factor is calculated from HCROI and personnel increase percentage.

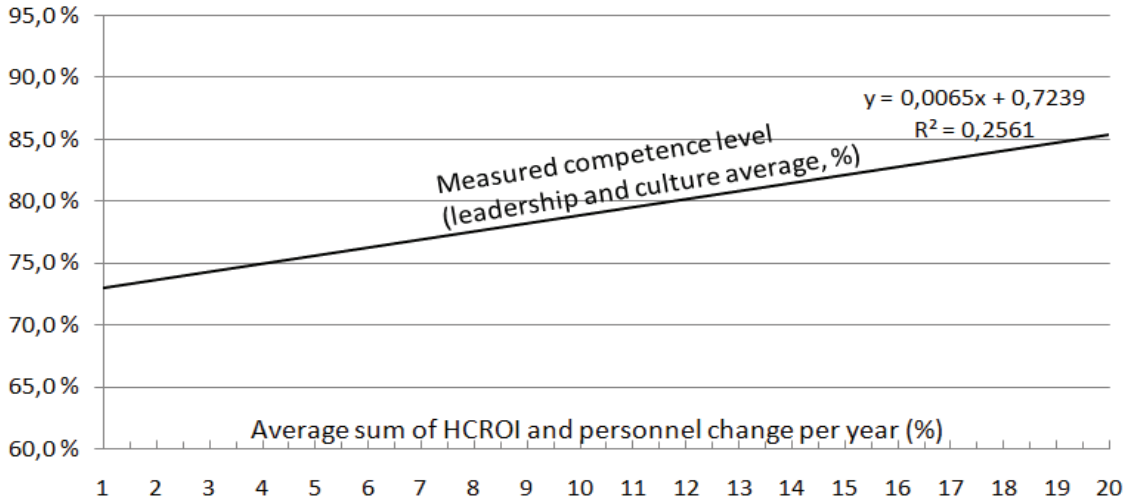

Figure 5. Trend line from competences (leadership and group culture) correlation to employee productivity (average of HCROI increase percentage and personnel increase percentage). Trend line correlation factor is 0,256.

It seems that average competence improvement is not only aim, but also increasing the weakest performing group's performances. These weakest performing groups are the majority and therefore producing the most value in organization productivity. This phenomen that was found at the case study is important to understand. For example the climate survey results are usually compared to average business branch values, which in respect of this new information is not enough. The competence variation seems to be as important, giving essential information about organization business performance. In this case study the average competence remained in good level but the variation was reduced significantly (see figure 6). At 2005 there were 20 % of units below 70 % competence and three years later every unit was over 70 % in measured competences (leadership and group culture). In this study the units are arranged in order of competences magnitude.

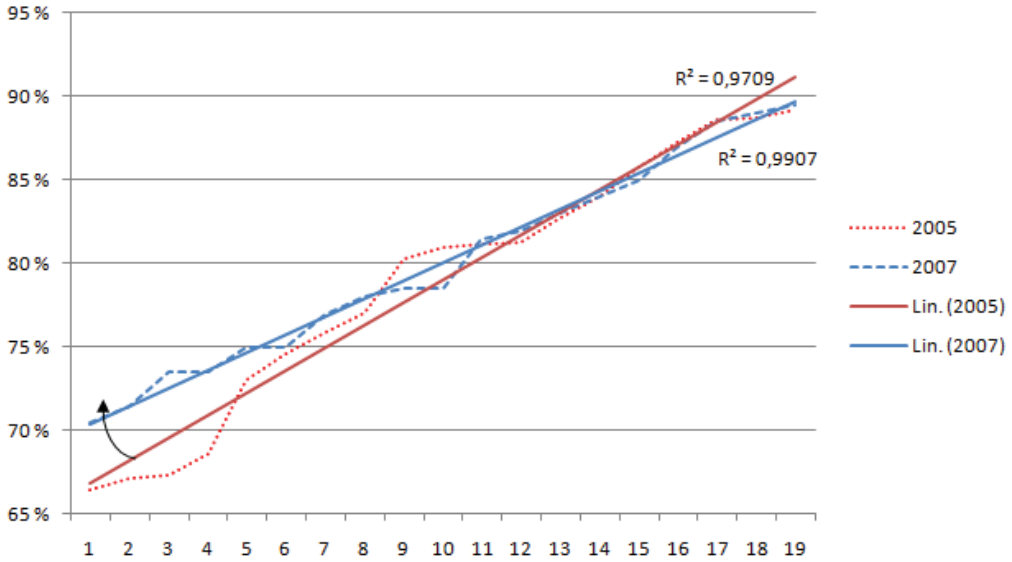

Figure 6. Figure shows the competence distribution in the beginning and after the organization change.

Same phenomen is visible at one year development where each unit is measured and arranged based on extent of unit's employee productivity (see figure 7). It seems that employee productivity goes together with competences. Also weakest performing unit's competences are improved most. Competence trend line break even in development is little over 80 %. It may so be that when groups self esteem gets better the group is motivated to take new challenges which stabilizes the competence and may even decrease it. Correlation to trend line is visible at figure 7 but not very strong indicating that there are lots of things affecting to each units competences.

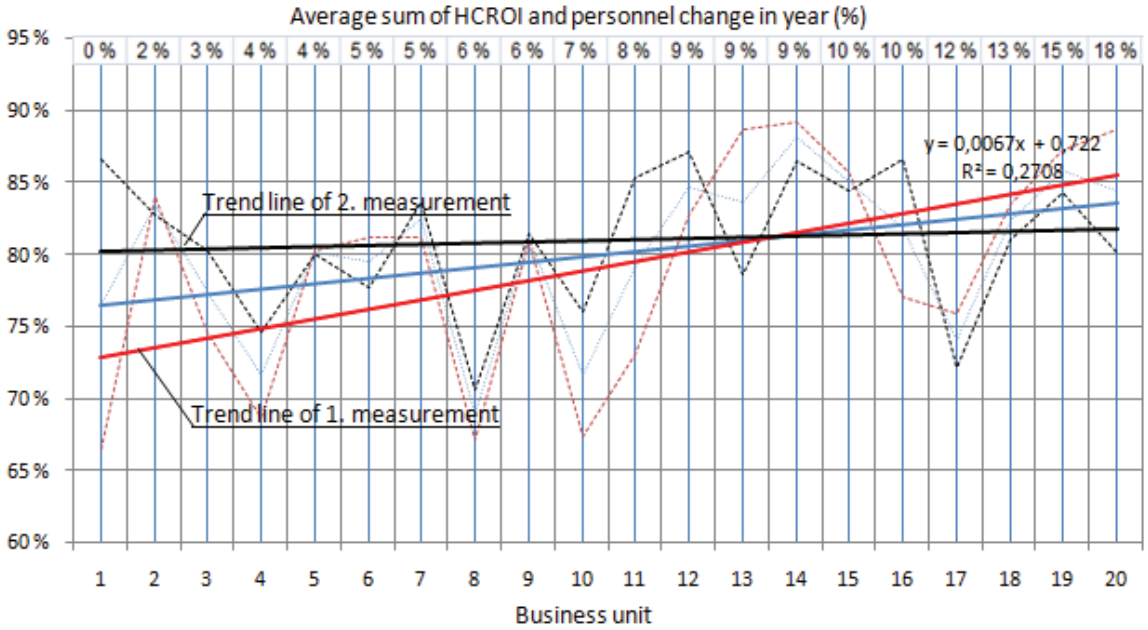

Figure 7. Business unit's competence development related to employee performance.

In this practical case the competences were developed systematically. However company average competence did not improve much but stayed at good level. We noticed that when the staff remained the same the competence improvement was more than in case where growth, transfer or reorganization changed the group arrangement. Figure 8 illustrates that groups are not improving competences so easily if group staff change is more than 15 % in year. The correlation in this phenomen was little over 20 %.

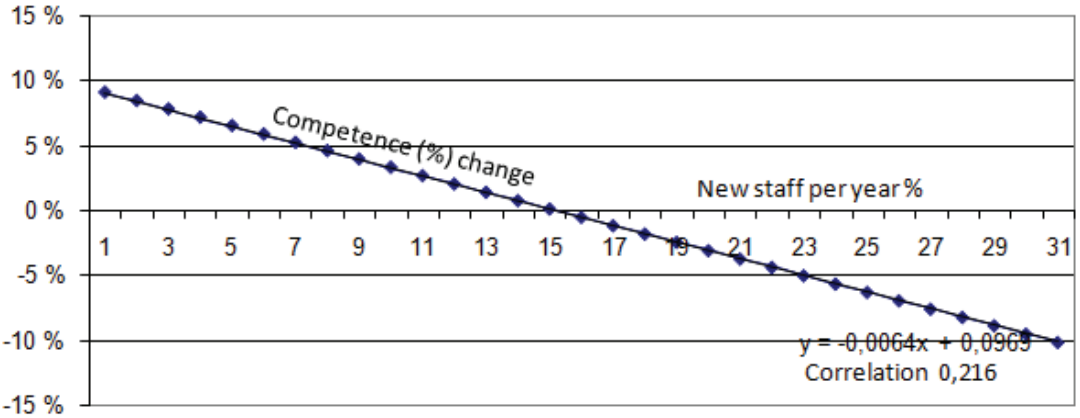

Figure 8. Measured competence change in correlation with new staff per year. Correlation factor is 0,216.

Systematic employee performance development using tacit signal method has shown to be effective in improving organization productivity. Following figure 9 shows that systematic whole organization development has improved the business performance significantly compared to average business branch. Productivity growth is a factor that comes from revenue multiplied with HCROI.

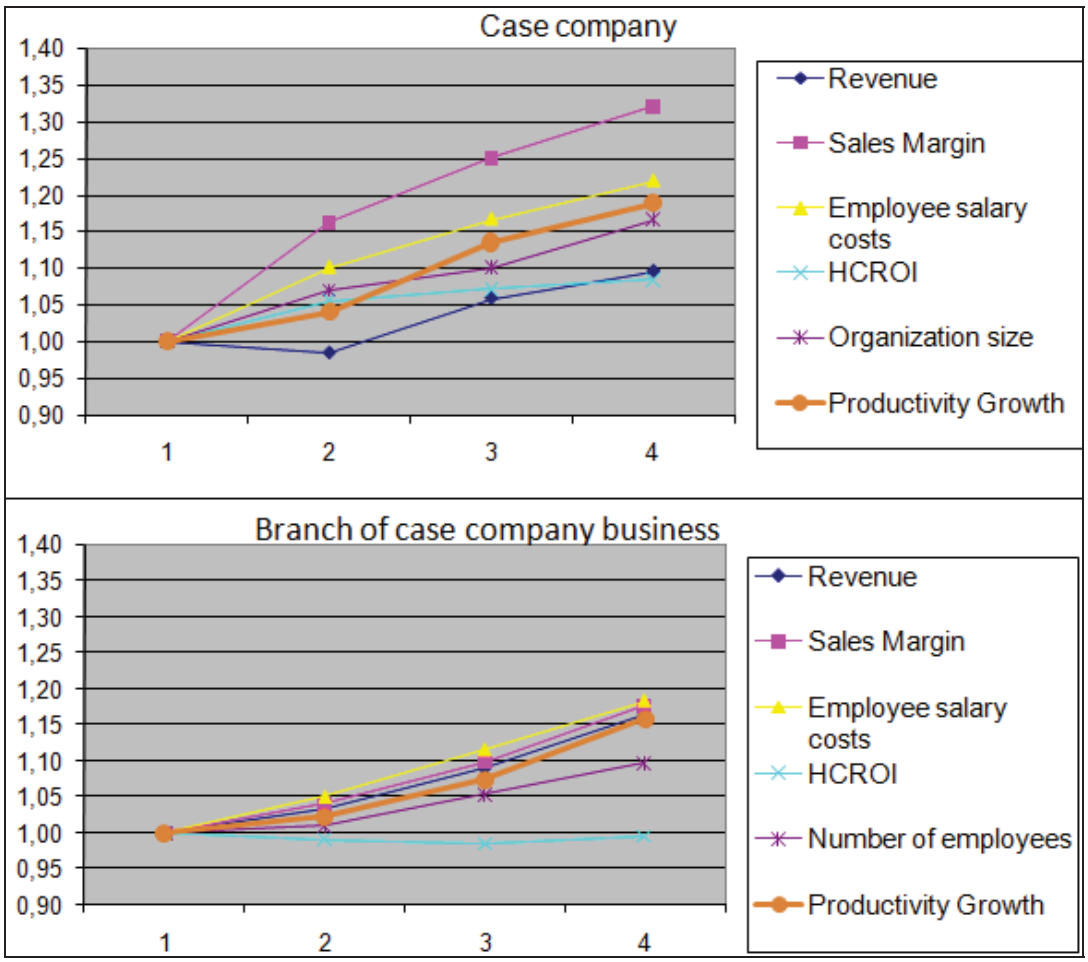

Figure 9. Case organization business scorecards compared to business branch at three years development period.

FUTURE TRENDS

Our investigation from several business and municipal companies in Finland indicates that when the organization size is more than 50 employees the main intangible drivers of performance are close to the same for all organization types. Syväjärvi (2005) has made the same observation in his academic dissertation. Empirically grounded approach to the organization development can be crystallized to the general system-theoretical approach to the organization development. We have noticed that competence levels are not stable but constantly changing. Organization structural changes, laying-offs and substantial growth decrease measured competences. Most probable there are several other reasons which cause decline in the competences. In constantly changing word it is the most advantageous competitive advantage if organization can improve weakest performing group's competences and so maintain constantly good level in business performance. We strongly believe that high

competence levels indicate also high innovativeness which helps organization to benefit business possibilities.

We believe that in the future the eHRM systems include intelligence in directing the organization to operate proactive and effectively in utilizing the human drivers of performance. Organization as a system is so complicated that managers and leaders are not able to do optimal decisions without the help of intelligent eHRM system. Our further study will connect the tacit signal eHRM measurement tool to our latest research of organizations performance as a system so that the managers can use the tool in fast decision making in managing and optimizing organization performance in long term.

CONCLUSION

Tacit signal method seems to get reliable information for effective organization development. Organization change and management needs understanding of humans in social relationship. Mental models describing this complexity can be useful when analyzing the situation and possible defects which disable competence development. Proper e-HRM systems should allow the organizational leaders to be more aware about human organizational behavior (e.g. Gibson et al., 2003). In improving organization productivity it seems that collective tacit knowledge is reliable in effective work practice development. Tacit signals together with systematic development services enable whole organization development. This is important since the majority of the groups need tools and expertise to succeed in their work practices improvement. Weakest performing groups produce the majority and are therefore the most potential in profitability improvement.
Agreed competences measurement and development are effective way to implement profitable growth strategy. By benefiting better the unidentified human assets, the public and private organizations can become aware how the human factors can create positive impact. When tacit signals are measured in real time and analyzing is guiding to the improvements, it is possible to start optimal development steps immediately. This has a motivation effect to all participants. It seems that tacit signals visualize collective competence in compliance with Yerkes-Dodson law (inverted U-curve).

The knowledge creation process requires that the measurement results are gone through with each working society. It is also recommendable that the management review is held before group development meetings. In this review the organization competence system model can be used. This guarantees that the complexity is understood and possible development obstacles are detected. After management review each group goes through their own results by constructive discussions. Groups also recognize the corrective actions and determine the most important. This group innovation forms effective foundation for knowledge creation corresponding the Nonaka and Nobory (1998) theory of ‘Ba’.

Our findings supports Argyris and Schon (1978) research, that to succeed the organization should have process where each person and group can reflect knowledge and experiences and so improve the contribution to the organization objectives. The tacit signal e-HRM tool produces valid data for decision making, strategic planning and more flexible working practices. These improvements can be linked to organization knowledge sharing, human wellbeing and productivity and thus supporting the organization performance management.

By measured tacit signals the group can improve the human competences which are linked to the business targets. For example leadership and proactive working culture are very important competences for collective efficiency. Proper HRIS is thus an extra way to develop effective leadership (e.g. Kets de Vries, 2006). We have experienced in many cases that in steady growing business environment the competences can be improved several percentages in one year. Our experience also indicates that the competence development relates with the improvement of human productivity measured by the metrics like HCROI (Human Capital Return on Investment). On the basis of several example cases, the current tacit signal e-HRM system is found to be useful for development purposes in public and private organizations.

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TERMS AND DEFINITIONS

Tacit signals: Human opinions and feelings that are guiding to the improvement of known human competence. Competences can be measured by tacit signals.

Competence attribute: A human property or characteristic in organizational environment that has value. It is one kind of data about the nature of the human-organization environment.

HCROI: Human Capital Return of Investment calculated from revenue less operating expenses (excluding personal costs) divided by the personal costs.
Employee productivity: Average of HCROI increase percentage and personnel increase percentage

Productivity growth: Factor that comes from revenue multiplied with HCROI.
Human competence: A human property or characteristic according to which one has knowledge, capability and skills in certain task to perform or behave. It is the organization's capability to benefit the known intangible drivers of performance for reaching its goals.

HRIS: Use of information technology to systemically generate relevant and timely information for the making of human resource management decisions. (rf. Stone, 2002)

Information system: An information system is a system of communication between people and it involves the gathering, processing and use of information.

Intangible assets: Human capital, database or information system, responsive process, customer relationship, innovation capability and culture of an organization that all are needed for distinctive and sustainable value.

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THE DIFFUSION OF INNOVATION AND PERCEIVED RISK FOR THE ADOPTION OF ALTERNATIVE ENERGY VEHICLES

Dr. Richard A. Feinberg, Purdue University, USA.
xdj1@purdue.edu
Hsin-Ying Wu, National Chiao Tung University, Taiwan.
cindywu.ms94g@nctu.edu.tw
Dr. Charles V. Trappey, National Chiao Tung University, Taiwan.
trappey@faculty.nctu.edu.tw

ABSTRACT

To reduce the dependency on foreign crude oil, many countries are promoting and regulating the use of alternative energy such as biofuels, hydrogen, solar energy and nuclear energy. Many researchers have studied alternative energy issues from a policy or industry viewpoint, but few have explored the consumer's beliefs and opinions. Since most applications of alternative energy are being developed for the consumer market, the consumer's acceptance and adoption of these new fuels and alternative energy vehicles are key factors to consider. This research studies the consumer's attitude toward vehicles using biofuel or hydrogen and evaluates the factors which influence the consumer's purchase decisions these cars.

Rogers' (1995) diffusion of innovation (DOI) and Bauer's (1960) perceived risk theory are used to design a national U.S. telephone survey (554 responses for the biofuels dataset and 443 responses for the hydrogen dataset). Ordinal logistic regression is used to analyze the factors which influence consumer's adoption of alternative energy vehicles. The results show that higher relative advantage, compatibility, observability and trialability leads to a higher probability of adopting a biofuel car. However, complexity is negatively related to the adoption of biofuel cars. While relative advantage, observability and trialability have a significantly positive relationships with the consumer's willingness to buy a hydrogen powered car, perceived risk significantly reduces the consumer's buying intention. Since these factors affect the consumer's purchase decisions, the results serve as a reference for marketers developing sales strategies for alternative energy cars.

Keyword: Adoption of innovation, Alternative energy, Biofuels, Hydrogen, Consumer behavior.

INTRODUCTION

The decision for consumers to adopt new forms of energy is an important issue for the global energy industry. New forms of energy for the marketplace, such as biofuels or hydrogen, require further research and development to match consumer lifestyles, channels of distribution, and product applications. Drastic oil price fluctuations during the year 2008 led the consumer

to new levels of energy awareness and searches for alternatives. For example, most consumers (European Commission, 2007) acknowledge that automobiles powered by gasoline emit CO_2 which in turn causes global warming. Since the US consumes up to 840 million gallons of petroleum per day and over 390 million gallons of gasoline were used for driving vehicles in 2008 (EIA, 2008), the US's transportation system is heavily reliant on oil. About 60 percent of the oil is imported into the United States (EIA 2008) which increases dependence on foreign sources of energy, a fact that is causing policy reviews and legislative debates at the highest levels of government. With a renewed focus on fuel conservation, the US is developing alternative fuels and encouraging drivers to consume non-gasoline fuels. The US government enacted the Energy Policy Act of 2005 to permit the partial tax reduction for the automobiles with alternative fuels and hopes to reduce gasoline consumption by 20% by the year 2017 (White House, 2007).

Other countries are also promoting and regulating the use of alternative fuels to resolve the crisis of global warming. In United Kingdom, greenhouse gas from transportation vehicles contributes to over a quarter of the total emissions. In order to reduce greenhouse gas emissions, the UK government stipulates that gasoline and diesel sold in retail stations should contain 2.5% biofuels and this ratio should increase to 5% by 2010 and 10% by 2015 (Perry and Rosillo-Calle, 2008). Brazil, as an alternative fuel leader, has endeavored to develop biofuels for 30 years (Pousa, Santos and Suarez, 2007). Mexico and Brazil promote ethanol fuels made from sugar cane and other countries, such as Germany, Hungary, Canada and Taiwan are promoting the increased use of biofuels and hold many related patents (Pintoa et al., 2005).

Many environmental experts believe that biofuels can reduce greenhouse gas and are a key solution to global warming (Fargione, Hill, Tilman, Polasky, and Hawthorne, 2008). However, other environmental groups warn that since biofuels are derived from corn, palm oil, soybean, and other agriculture products, their increased use for fuels may drive up prices and create a food crisis (Brown, 2006; Mitchell, 2008; Tenenbaum, 2008). The U.N. Food and Agriculture Organization's global food price index rose 40 percent in 2007 (von Braun, 2008) and biofuels have forced global food prices up by 75% (Chakrabortty, 2008). The countries cultivating products for alternative fuels are replacing the production of food for people; therefore, people in developing countries are facing greater food shortages. However, the creation of alternative energies is also necessary for developing and developed economics (Popp, 2001). This research study explores the consumer's attitude toward vehicles driven by new forms of energy, such as biofuels or hydrogen, and evaluates the factors which influence the consumer's purchasing decisions for alternative fuel cars.

There is the wide variety of alternative energy such as biofuels, hydrogen, solar energy and nuclear energy. This research focuses on biofuels and hydrogen. Biofuels are an important potential energy source for the United States because bioenergy crops used to produce energy can be cultivated on dormant farmland. Using biomass for energy production helps the US decrease the reliance on foreign energy and reduce emissions (Greene et al., 2004). Hydrogen

is a clean energy source with no CO_2 emissions and no air pollutants. The emission-free character of hydrogen has brought this alternative to the forefront policy initiatives (Ball and Wietschel, 2008). However, the public has limited knowledge about hydrogen fuel technology and are frequently concerned about the safety issues after remembering the Hindenberg of rigid airships disaster of 1937. However, as the technology has developed, the safety of hydrogen as an alternative fuel has greatly improved. Hydrogen is a reliable energy source but a new delivery infrastructure is needed before the fuel can be safely transferred into vehicles. Consumer's attitudes toward hydrogen likely influence their adoption of the technology of hydrogen-related product. Thus, before investing in an expensive hydrogen delivery infrastructure, more knowledge concerning the consumer's perceptions of the safety and utility of hydrogen is needed.

The research framework for this study is based on the Rogers' (1995) diffusion of innovation (DOI) and Bauer's (1960) perceived risk theory. There are five innovation characteristics of the DOI and these characteristics include relative advantage, compatibility, complexity, trialability, and observability. Roger's factors influence people's adoption process for an innovation technology or a new concept. The study also applies the concept of perceived risk proposed by Bauer (1960) to discuss consumers' adoption process for alternative energy automobiles. In order to understand the characteristics of potential buyers, several socio-demographic variables are also included in the research framework.

Section 1 of this paper provides an introduction and Section 2 discusses the Rogers' (1995) diffusion of innovation (DOI) and Bauer's (1960) perceived risk theory. Following the proposed hypotheses of this study, Section 3 describes the methodology and Section 4 presents the data analysis and analytical results. The last section provides a summary and conclusion as well as the discussion of the study.

LITERATURE AND RESEARCH HYPOTHESES

Alternative energy cars can be views as an innovation. Therefore, Rogers' diffusion of innovation is applied to explore the consumer's attitude and purchasing decision for an alternative energy car. Besides, Bauer's perceive risk is included in this study to compare and contrast the fuel alternatives. This section introduces the diffusion of innovations and perceived risk and proposes the hypotheses based on these theories.

Diffusion of innovations

Diffusion of innovation theory (DOI) was proposed in 1962 by Rogers who defined the word "innovation" as an idea, habit, or object perceived to be new by people or adopters. Thus, if an idea is a new concept to a person, then the concept is an innovation. Rogers defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social society." There are three characteristics of diffusion. Diffusion happens overtime and as people wait to adopt an innovation they undergo the stages of the adoption process. The attributes of innovation, the organizations, and the people involved also

influence the rate of adoption. Therefore, DOI illustrates who adopts what products, what technologies, what methods, and what ideas, and when, where, how, and why the adoption occurs (Rogers, 1983, 1995).

Rogers proposed a revised model for the consumers' adoption process called the "Innovation Decision Process." Consumers form attitudes toward an innovation after perceiving the innovation and then they decide whether to adopt the innovation or not. Once they adopt, they execute the decision and then reevaluate the decision. There are five stages underlying the process. The first stage is the knowledge stage where consumers learn of an innovation. The second stage is called the persuasion stage and consumers express their attitudes (likes or dislikes) toward the innovation and pursue the information related to the innovation. In the third stage, the decision stage, consumers either decide to adopt or refuse the innovation. In the fourth stage, implementation, consumers face a choice whether they should use the innovation or not. Note that consciously adopting the innovation is different from the practical implementation the innovation. During the confirmation stage, consumers may change their decision after gathering conflicting information.

Rogers outlines five attributes of innovation from the literature. These attributes affect the consumers' adoption of innovation (AOI) and include relative advantage, compatibility, complexity, trialability, and observability. Relative advantage means that the new innovation is considered better than the consumers' current product. Economic benefit, social status, convenience, or satisfaction can be used to determine whether the innovation has a relative advantage or not. The relative advantage is positively related to the AOI, so if the consumers perceive advantage is high, then they will likely adopt the innovation. Alternative energy vehicles with environmentally friendly features such as reduced or less toxic exhaust emissions make these vehicles more attractive to environmental conscious consumers and are increasingly providing economic advantage over conventional automobiles. Thus, it is expected that consumers who perceive alternative energy vehicles as advantageous will be more likely to adopt the innovation. Compatibility describes the degree to which an innovation is compatible with current values, former experiences, and needs. Higher compatibility determines higher probability of innovation acceptance. Researchers found that an innovation is more likely to be adopted when it is compatible with the consumers' value. Therefore, it is expected that consumers will be more likely to adopt alternative energy vehicles when they perceive the vehicle as compatible with their lifestyles. Complexity describes the degree to which an innovation is difficult to understand or use and is negatively related to the AOI. As the model of alternative energy car is different from traditional gasoline car, it is likely that potential customers may feel that alternative energy car are complex to use, and hence would be not likely to use these types of cars. Trialability measures the degree that an innovation can be tried or experienced and is positively related to the AOI. If consumers can try an innovation they are more likely to adopt. Thus, if consumers express more willingness to try an alternative energy car, they are more likely to adopt. Finally, observability measures the visibility of the innovation to others and is positively related to the AOI. The more consumers observe the

usage and function of the technology, the more likely they will adopt. So, if consumers observe the function of an alternative energy car, they are more likely to adopt.

Taylor and Todd (1995a) studied how consumers are affected by the attributes of innovation when they adopt a new product. The results showed that greater the relative advantage of the product relative to what was used before, the higher possibility of adopting the innovation. An important contribution of the study shows that consumers are willing to adopt an innovation when it is not complicated. Taylor and Todd (1995b) used the attributes of innovation to analyze the behavior of students in an information center. The results showed that students that acknowledged the relative advantage of the center hold a more positive attitude toward the center. Many researches have applied the AOI attributes to measure the adoption of new products or technologies and have found a significant relationship between the attributes and the adoption behavior (Al-Gahtani, 2003; Gatignon and Robertson, 1985; LaBay and Kinnear, 1981; Moore and Benbasat, 1991; Tan and Teo, 2000). Therefore, the attributes of innovation are useful measures for the adoption of an innovation and serve as a reliable means to forecast public acceptance. Based on the literature above mentioned, five hypotheses are proposed in the study:

H1: The greater the perceived relative advantage of using an alternative energy vehicle, the more likely that alternative energy vehicle will be adopted.

H2: The greater the perceived compatibility of an alternative energy vehicle with one's values, the more likely that alternative energy vehicle will be adopted.

H3: The lower the perceived complexity of using an alternative energy vehicle, the more likely that alternative energy vehicle will be adopted.

H4: The greater the trialability of an alternative energy vehicle, the more likely that alternative energy vehicle will be adopted.

H5: The greater the observability of an alternative energy vehicle, the more likely that alternative energy vehicle will be adopted.

Perceived Risk

Perceived risk was defined by Bauer in 1960. The basic concept of perceived risk is that if consumers are aware of the risks of their behavior, then they will try to reduce these risks. Bauer (1960) states that if consumers cannot determine the benefits prior to purchasing a product, then they are engaging in risk taking behavior. Perceived risk is determined by the expected results of the purchasing decision and the degree of the uncertainty. If the expected result is more important or the uncertainty is higher, then perceived risk to the consumer is higher.

Cox (1967) notes that if consumers are goal orientated, then they set a target for their purchasing action. If consumers cannot decide which purchasing decision can fit their target or if the decision cannot meet their expectations, consumers may feel they have made a wrong decision. Therefore, if consumers assume this regret will occur, then they will experience

perceived risk. Dowling and Staelin (1994) define perceived risk as the disadvantage or uncertainty that occurs when purchasing.

Researchers agree that there are many dimensions of perceived risk. Jacoby and Kaplan (1972) outline five dimensions for perceived risk: financial risk, performance risk, physical risk, social risk, and psychological risk. Financial risk describes that consumers may experience financial loss when the products or services fail to represent their value or display their expected function. Performance risk means consumers need to spend time to repair or adjust the products or services when they malfunction and do not operate normally. Physical risk implies that the products or services may harm consumers' health. Social risk indicates that the consumer may be assessed negatively by others after using the products or services. Psychological risk means consumers may feel guilty or regret after purchasing the products or services that do not satisfy consumers' expectations. Roselius (1971) lists four losses consumers may experience when purchasing. Time loss refers to the losses that occur when a product cannot function normally and consumers need to spend time repairing, adjusting, or exchanging the product. Hazard loss implies a product may endanger a consumers' health or security. Ego loss describes that consumers may lose their self confidence since they bought a defective product and other people treat the purchase as a foolish decision. Monetary loss means the expenditure comes from repairing or exchanging a defective product. Therefore, if consumers experience perceived risk toward a product or service, they may not make a purchase. Similarly, if an innovation is considered risky, then there is less chance that it will be adopted.

Ostlund (1974) used perceived risk as an additional variable to measure adoption of innovation (AOI). It is expected that only consumers who perceive using alternative energy car as a low risk behavior will likely adopt it. This leads to the hypothesis:

H6: The lower the perceived risk of using an alternative energy vehicle, the more likely that alternative energy vehicle will be adopted.

Social demographic characteristics

Social demographic characteristics, such as gender, education, age and income are also included in the research. The literature shows that the demographic variables may or may not influence consumer's adoption of innovation. However, some research indicates that demographic variable significantly affected the adoption of an innovation, and Gatingnon and Robertson (1985) concluded that higher income, better educated, and younger consumers are more likely to accept an innovation. Foxell (1995) found that demographic variables are positively related to new innovation adoption of computer software but not in the adoption of food innovations. Kolodinsky, Hogarth, and Hilgert (2004) concluded that some demographic variables, such as income and age are significantly related to the adoption of E-banking, while gender, marital status, race, and region are not. Taylor and Todd (1995b) could not establish a relationship between demographic variables and student's adoption of an information center. The study of Ostlund (1974) shows that the effect of demographic variables on AOI is weak.

Since there are no empirical results about the effect of demographic variables on the adoption of alternative energy cars, these variables are included in the research framework. Furthermore, the demographic variables are also used to analyze the potential consumers of alternative energy vehicles.

METHODOLOGY

This study assumes that if consumers wish to buy alternative energy powered vehicles then they are adopting an innovation. Rogers's five attributes of adopting an innovation (AOI), relative advantage, compatibility, complexity, trialability, and observability, affect consumer's decision of adopting the innovation. Perceived risk is often introduced in experiments by researchers studying the adoption of an innovation (Bauer, 1960; Ostlund, 1974). Thus, this study assumes that there are six variables that influence consumer's adoption of alternative energy vehicles. Since biofuels and hydrogen can reduce emissions and are clean energy, many countries promote these two energy as substantial energy resources. Therefore, this study emphasizes on the use of biofuels and hydrogen and discusses the factors that influence consumer's purchasing decision towards biofuels and hydrogen powered cars.

A questionnaire is designed to evaluate consumer's perception toward biofuels or hydrogen powered cars. The corresponding questions for biofuels are listed in Table 1 and similar questions are asked for hydrogen (Appendix 1). Answers ranged from 1 (very low degree on the AOI attributes) to 5 (very high degree on the attributes), and -8 (respondents don't know the topic) and -9 (respondents refuse to answer the question). Demographic variables are included in the questionnaire to analyze respondents' characteristics.

Table 1. Description of questions about biofuels and the corresponding dimensions

	Questions in the survey	Corresponding dimensions
1	To what extent do you think that biofuels, like ethanol, have advantages over gasoline?	Relative Advantage
2	To what extent is the use of biofuels compatible with your values?	Compatibility
3	To what extent is use of biofuels a complex issue?	Complexity
4	How risky is the use of biofuels?	Perceived risk
5	How likely is it that you will know if your friends are using biofuels in their cars?	Observability
6	How likely would you be to try biofuels when they are available at your filling station?	Trialability

The data was collected using telephone interviews conducted by the University of Florida Survey Center. The samples were created by randomly generating and calling US telephone numbers. Dialing was conducted from 9:00 AM to 9:00 PM local time from Monday through Friday. Weekend dialing was conducted from 12:00 PM - 9:00 PM local time, and Sunday dialing started at 2:00 PM - 9:00 PM. Call outs were made to the Eastern, Central, Mountain

and Pacific Time zones. One thousand and forty nine samples were collected. After deleting data with missing values, 554 samples were collected for the biofuels dataset and 443 samples for the hydrogen dataset.

To analyze the potential adopters of alternative energy cars, the samples are categorized into high alternative energy cars buying intention respondents and low buying intention respondents. High buying intention respondents are those who say they are very likely or somewhat likely to buy a car that runs on biofuels or hydrogen when the car is available and are ranked as low buying intention respondents otherwise. A T-test is applied to see the difference between high and low buying intention groups. Ordinal logistic regression is used to test the research hypotheses since the dependent variables are ordinal data, including level of willingness to buy a biofuels or hydrogen car (Cooper and Zmud, 1990).

DATA ANALYSIS AND RESULTS

The demographic characteristics for gender, education, age and total annual household income are presented in Table 2 and Table 3. The sample characteristics for biofuels and hydrogen are similar. Sixty percent of the respondents were male, half had college degrees, 30% had a total annual household income between $30,000 to $60,000, and over 60% of the respondents are middle age (35-65). Furthermore, we compare high alternative fuel powered car buying intention respondents and with low buying intention respondents. As shown in Table 2, female respondents tend to have a lower propensity to buy biofuels cars. Higher educated respondents (248) express a desire to buy biofuels cars and Table 3 displays the buying intention for hydrogen cars. 70% of the male respondents indicate a willingness to buy a hydrogen car, and respondents 51 to 66 years old (115) are more likely to buy a hydrogen car. Further, those whose annual household income between $30,000 to $90,000 (147) express a higher propensity to buy a hydrogen car.

Table 4 and Table 5 show the mean and the standard deviation of the demographic variables and the six dimensions of adoption of innovation (AOI) and the high and low propensity grouping. A T-test is applied to see if there is a significant difference between high and low buying propensity across the demographic variables. In this study, we found that the demographic variables play different roles in the biofuels and hydrogen dataset. In the biofuels dataset, there is no difference between high and low propensity across the demographic variables. However, in hydrogen dataset, gender, education, income and age are all significantly different between buyers with high and low propensity. In addition, higher income, better educated, younger consumers have a higher propensity to buy hydrogen powered cars. This result is similar to that of Gatignon and Robertson (1985) where they proposed consumers with these characteristics are more likely to adopt an innovation. Table 4 addresses the results for group differences between high and low propensity buyers of biofuels powered cars and Table 5 addresses the results for hydrogen powered cars. The results of the t-test reveal that all six dimensions of AOI, expect for complexity, are statistically different between high and low propensity groups for both biofuels and hydrogen datasets. Complexity

cannot be shown to influence the consumer's purchasing decision on buying a biofuels or hydrogen powered car. The results also show that relative advantage, compatibility, observability and trialability are positively relative to the consumers' intention to buy a biofuels or hydrogen powered car. Furthermore, perceived risk is negatively related to the buying intention of biofuels or hydrogen powered cars. The three most important attributes that influence consumer's alternative energy car buying decision for the high buying propensity group are trialability, compatibility, and relative advantage.

Using multivariate analysis, all variables are included in the model to analyze the factors that influence consumer's decision on purchasing an alternative energy car. As shown in Table 6 and Table 7, model 1 is for the demographic variables only and model 2 contains the demographic variables plus the six AOI dimensions. In Table 6, the demographic variables are not statistically significant for consumers purchasing a biofuel car. In model 2, when adding the AOI dimensions, the results are also not significant. As for the regression results of AOI dimensions in Table 6, the complexity and perceived risk are negatively related to the adoption of the biofuels car, but the perceived risk is not significant. The remaining four dimensions positively affect the adoption of the biofuels car, which means higher relative advantage, compatibility, observability and trialability leads to higher probability of biofuels car adoption. Therefore, hypotheses H1 through H5 for biofuels powered cars are significant and are supported.

Table 7 shows the ordinal regression results for hydrogen powered cars. For model 1, gender is a statistically significant variable which affects the consumer's decision to purchase a hydrogen powered car. Moreover, male consumers are more likely to buy a car that runs on hydrogen. The remaining demographic variables of education, income and age, excluding the dummy variable for ages 51-65 in model 1, are not statistically significant. Overall, the results are similar to the biofuels dataset and show that the consumer's education, income and age significantly influence their decision to adopt a hydrogen powered car. For the six dimensions of AOI in model 2 (Table 7), the relative advantage, observability and trialability have significantly positive relationships with the consumer's willingness to buy a hydrogen powered car. The results are different from the biofuels dataset. For the hydrogen dataset, there was no significant effect for compatibility or complexity on the buying intention for a hydrogen powered car. However, perceived risk is significant and negative for the buying intention of a hydrogen car. Therefore, the hypotheses H1, H4, H5, and H6 are supported for hydrogen powered cars, while H2 and H3 are not.

Table 2. Sample characteristics of biofuels cars

Variables	Total sample		High propensity		Low propensity	
	Count (Percentage)	Biofuels car buying intention	Count (Percentage)	Biofuels car buying intention	Count(Percentage)	Biofuels car buying intention
Gender (male=1)						
Male	333 (60.11)	3.25	206 (60.95)	4.46	110 (58.20)	1.36
Female	221 (39.89)	3.36	132 (39.05)	4.42	79 (41.80)	1.32
Education						
1. High School	153 (27.62)	3.18	90 (26.63)	4.49	62 (32.80)	1.29
2. College	295 (53.25)	3.37	182 (53.85)	4.45	95 (50.27)	1.38
3. Graduate or professional school	106 (19.13)	3.36	66 (19.52)	4.38	32 (16.93)	1.34
Income						
1. Under $30,000	117 (21.12)	3.14	65 (19.23)	4.51	49 (25.93)	1.33
2. $30,000-59,999	168 (30.32)	3.42	107 (31.66)	4.44	52 (27.51)	1.38
3. $60,000-89,999	119 (21.48)	3.34	77 (22.78)	4.38	37 (19.58)	1.24
4. $90,000-119,999	62 (11.19)	3.37	38 (11.24)	4.55	20 (10.58)	1.20
5. over $120,000	88 (15.88)	3.30	51 (15.09)	4.41	31 (16.40)	1.52
Age						
1. Under 25	30 (5.42)	3.40	18 (5.33)	4.61	11 (5.82)	1.45
2. 26-35	63 (11.37)	3.25	35 (10.36)	4.43	20 (10.58)	1.30
3. 36-50	152 (27.44)	3.37	94 (27.81)	4.46	50 (26.46)	1.38
4. 51-65	199 (35.92)	3.46	134 (39.64)	4.43	59 (31.21)	1.31
5. 66-75	64 (11.55)	3.05	35 (10.36)	4.37	26 (13.76)	1.27
6. over 75	46 (8.30)	2.96	22 (6.50)	4.55	23 (12.17)	1.43
Total Sample size	554		338		189	

Table 3. Sample characteristics of hydrogen cars

Variables	Total sample		High propensity		Low propensity	
	Count (Percentage)	Hydrogen car buying intention	Count (Percentage)	Hydrogen car buying intention	Count (Percentage)	Hydrogen car buying intention
Gender (male=1)						
Male	283 (63.88)	3.64	201 (68.84)	4.47	72 (55.38)	1.42
Female	160 (36.12)	3.13	91 (31.16)	4.33	58 (44.62)	1.28
Education						
1. High School	115 (25.96)	3.22	70 (23.97)	4.44	42 (32.31)	1.19
2. College	243 (54.85)	3.51	161 (55.14)	4.44	69 (53.07)	1.42
3. Graduate or professional school	85 (19.19)	3.65	61 (20.89)	4.38	19 (14.62)	1.47
Income						
1. Under $30,000	102 (23.02)	3.09	59 (20.21)	4.44	42 (32.31)	1.19
2. $30,000-59,999	132 (29.80)	3.36	79 (27.05)	4.43	44 (33.85)	1.52
3. $60,000-89,999	92 (20.77)	3.77	68 (23.29)	4.44	17 (13.08)	1.41
4. $90,000-119,999	50 (11.29)	3.82	40 (13.70)	4.48	10 (7.69)	1.20
5. over $120,000	67 (15.12)	3.51	46 (15.75)	4.35	17 (13.08)	1.35
Age						
1. Under 25	31 (7.00)	3.61	23 (7.88)	4.35	8 (6.15)	1.50
2. 26-35	55 (12.42)	3.35	33 (11.30)	4.45	17 (13.08)	1.29
3. 36-50	126 (28.44)	3.44	81 (27.74)	4.38	35 (26.92)	1.37
4. 51-65	151 (34.09)	3.77	115 (39.38)	4.46	32 (24.62)	1.41
5. 66-75	40 (9.03)	2.95	22 (7.53)	4.36	18 (13.85)	1.22
6. over 75	40 (9.03)	2.88	18 (6.16)	4.56	20 (15.38)	1.35
Total Sample size	443		292		130	

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Table 4. Result of t-test for group differences between high and low propensity to buy a biofuels powered car

Variables	Mean (Standard deviation)		
	Total sample	High propensity	Low propensity
Gender (male=1) Male Female	0.60 (0.49)	0.61 (0.49)	0.58 (0.49)
Education 1. High School 2. College 3. Graduate or professional	1.92 (0.68)	1.93 (0.68)	1.84 (0.69)
Income 1. Under $30,000 2. $30,000-59,999 3. $60,000-89,999 4. $90,000-119,999 5. over $120,000	2.70 (1.35)	2.71 (1.31)	2.64 (1.40)
Age 1. Under 25 2. 26-35 3. 36-50 4. 51-65 5. 66-75 6. over 75	3.62 (1.23)	3.59 (1.17)	3.73 (1.33)
Relative Advantage (1-5)***	3.65 (0.98)	3.88 (0.86)	3.26 (1.07)
Compatibility (1-5)***	3.69 (1.13)	3.99 (1.03)	3.18 (1.16)
Complexity (1-5)	3.59 (1.13)	3.52 (1.14)	3.66 (1.17)
Perceived Risk (1-5)***	2.29 (0.90)	2.18 (0.84)	2.48 (0.97)
Observability (1-5)***	3.51 (1.54)	3.81 (1.41)	3.05 (1.66)
Trialability (1-5)***	3.95 (1.35)	4.49 (0.89)	3.01 (1.53)
Sample size	554	338	189

Note: ***: $p<0.01$ show the result of the t-test for group differences between adaptors with a high propensity to buy and low propensity to buy a biofuels car. The group is divided into groups based on their survey response. Very likely and somewhat likely are classified into high propensity; very unlikely and somewhat unlikely are classified into low propensity.

Table 5. Result of t-test for group differences between high and low propensity to buy a hydrogen powered car

Variables	Mean (Standard deviation)		
	Total sample	High propensity	Low propensity
Gender (male=1)***	0.64 (0.48)	0.69 (0.46)	0.55 (0.50)
Male			
Female			
Education***	1.93 (0.67)	1.97 (0.67)	1.82 (0.66)
1. High School			
2. College			
3. Graduate or professional school			
Income***	2.66 (1.35)	2.78 (1.34)	2.35 (1.35)
1. Under $30,000			
2. $30,000-59,999			
3. $60,000-89,999			
4. $90,000-119,999			
5. over $120,000			
Age***	3.53 (1.28)	3.46 (1.21)	3.73 (1.43)
1. Under 25			
2. 26-35			
3. 36-50			
4. 51-65			
5. 66-75			
6. over 75			
Relative Advantage (1-5)***	3.83 (0.98)	4.07 (0.84)	3.30 (1.11)
Compatibility (1-5)***	3.78 (1.11)	4.02 (0.99)	3.27 (1.21)
Complexity (1-5)	3.70 (1.19)	3.63 (1.20)	3.80 (1.20)
Perceived Risk (1-5)***	2.93 (0.95)	2.77 (0.89)	3.24 (1.02)
Observability (1-5)***	3.60 (1.54)	3.86 (1.43)	3.02 (1.64)
Trialability (1-5)***	3.79 (1.42)	4.41 (0.87)	2.51 (1.57)
Sample size	443	292	130

Note: ***: $p<0.01$ show the result of the t-test for group differences between adaptors with a high propensity to buy and low propensity to buy a hydrogen car. The group is divided into groups based on their survey response. Very likely and somewhat likely are classified into high propensity; very unlikely and somewhat unlikely are classified into low propensity.

Table 6. Ordinal logistic regression on the "buy a biofuels car"

Variable	Model 1 Demographic variables			Model 2 All variables		
	Coefficients	P-values	Logistic odd	Coefficients	P-values	Logistic odd
Gender (male=1)	0.1712	0.2859	1.1868	0.2051	0.2324	1.2277
Education (High School)	-0.0784	0.7520	0.9246	0.2445	0.3619	1.2770
Education (College)	0.0504	0.8104	1.0517	0.1994	0.3749	1.2207
Income (Under $30,000)	-0.0116	0.9663	0.9885	-0.0736	0.8021	0.9290
Income ($30,000-59,999)	0.1880	0.4381	1.2069	0.0072	0.9778	1.0072
Income ($60,000-89,999)	0.0355	0.8894	1.0361	-0.3155	0.2492	0.7294
Income ($90,000-119,999)	0.1368	0.6461	1.1466	0.1314	0.6819	1.1404
Age (Under 25)	0.5144	0.2223	1.6727	-0.0747	0.8675	0.9280
Age (26-35)	0.2318	0.5082	1.2609	-0.1722	0.6490	0.8418
Age (36-50)	0.4343	0.1622	1.5439	-0.0436	0.8962	0.9574
Age (51-65)	0.5110	0.0882	1.6670	0.1094	0.7343	1.1156
Age (66-75)	-0.0044	0.9900	0.9956	-0.0229	0.9511	0.9773
Relative Advantage				**0.2927*** **	**0.0018**	**1.3401**
Compatibility				**0.2609*** **	**0.0021**	**1.2981**
Complexity				**-0.1517****	**0.0433**	**0.8592**
Perceived Risk				-0.1095	0.2584	0.8963
Observability				**0.3137*** **	**0.0000**	**1.3685**
Trialability				**0.7419*** **	**0.0000**	**2.1000**
Overall model significance	854.7466	0.6846		1347.4622	**0.0000**	
Number of observations	554			554		

Note: ***: p<0.01; **: p<0.05

Table 7. Ordinal logistic regression on the "buy a hydrogen car"

Variable	Model 1 Demographic variables			Model 2 All variables		
	Coefficients	P-values	Logistic odd	Coefficients	P-values	Logistic odd
Gender (male=1)	**0.7381*** **	**0.0001**	**2.0920**	**0.5316** **	**0.0103**	**1.7016**
Education (High School)	-0.3279	0.2609	0.7204	-0.2743	0.3977	0.7601
Education (College)	-0.1510	0.5300	0.8599	-0.1404	0.5931	0.8690
Income (Under $30,000)	-0.1175	0.7097	0.8891	-0.2853	0.4128	0.7518
Income ($30,000-59,999)	0.0200	0.9436	1.0202	-0.0063	0.9838	0.9937
Income ($60,000-89,999)	0.4517	0.1290	1.5709	0.1573	0.6306	1.1704
Income ($90,000-119,999)	0.4546	0.1863	1.5755	0.0982	0.7924	1.1031
Age (Under 25)	0.7559	0.0875	2.1295	0.3669	0.4576	1.4432
Age (26-35)	0.3894	0.3068	1.4761	-0.4096	0.3337	0.6639
Age (36-50)	0.4988	0.1442	1.6467	-0.0685	0.8585	0.9338
Age (51-65)	**0.9874*** **	**0.0032**	**2.6841**	0.3679	0.3302	1.4447
Age (66-75)	-0.1536	0.7114	0.8576	-0.5492	0.2386	0.5774
Relative Advantage				**0.3626*** **	**0.0014**	**1.4371**
Compatibility				0.1598	0.1103	1.1733
Complexity				-0.1053	0.2162	0.9001
Perceived Risk				**-0.3939*** **	**0.0003**	**0.6744**
Observability				**0.1634** **	**0.0158**	**1.1775**
Trialability				**0.9615*** **	**0.0000**	**2.6157**
Overall model significance	679.3335	**0.0000**		951.4468	**0.0000**	
Number of observations	443			443		

Note: ***: p<0.01; **: p<0.05

CONCLUSION

When discussing alternative energy adoption, most studies apply the viewpoint of industry and provide little research about the adoption from the consumer's point of view (Faiers and Neame, 2006; Kilinc, Stanisstreet, and Boyes, 2008). Therefore, this study focuses on exploring the factors that influence the consumer's adoption of alternative energy cars that run on biofuels and hydrogen.

The results of biofuels dataset shows that four dimensions of AOI, relative advantage, compatibility, observability and trialability, have positive relationships with the consumer's decision on purchasing a biofuel powered car. The other dimension of AOI, complexity, is significantly related to the consumer's biofuels powered car purchase decision. Rogers' five attributes of AOI are all related to the adoption of biofuels powered car, which means Rogers' theory fits this sample for explaining and predicting the adoption of biofuels cars. Although there are a number of ways to ask consumers why they adopt an innovation, Rogers' theory requires fewer questions and is particularly well suited to a phone survey. On the other hand, Bauer's perceived risk factor is not significantly related to the willingness to buy a biofuel powered car, which means the risk of using biofuels does not affect the consumer's purchase intentions. However, for the hydrogen dataset, perceived risk is significantly associated with the willingness to buy a hydrogen powered car. This indicates that consumers do not trust the safety of hydrogen as a fuel and consider buying a hydrogen powered car as a risk-taking decision. Sherif, Barbir, and Veziroglu (2005) mentioned the safety of hydrogen in their research. Since hydrogen is a diatomic gas with high flammability, that is easy to leak and can readily cause fires as well as explosions. These characteristics underlie the consumers worry about the risk of using the energy. Besides, gender, relative advantage, observability and trialability have a significantly positive relationship with the consumer's decision to buy a hydrogen powered car.

Trialability, observability, and relative advantage are the three factors that significantly affect the consumer's decision to purchase a biofuels or hydrogen powered car. Since trialability plays an important role for a new innovation product for early adopters (Gunderman and Meesa, 2008), manufacturers should encourage car trials for consumers in an attempt to increase their willingness to purchase the car.

Consumers will not adopt an innovation unless they are aware of it, observe it, and learn about it from others. Therefore, the alternative energy car manufacturers should design the alternative energy car differently from the traditional gasoline powered cars. The difference should be visible and when the alternative energy cars are driven on the road, so consumers can tell the difference. The observed difference will likely increase the consumer's

willingness to buy an alternative energy powered car. For example, Toyota alters the appearance of the Prius hybrid car so that it has a flat shape and a highly noticeable hybrid decal.

Relative advantage is significant factor underlying the consumer's decisions to adopt an alternative energy vehicle. Thus, if manufacturers promote the relative advantage of the biofuels or hydrogen powered cars (e.g., lower the price), the willingness to adopt biofuels powered cars will highly increase. Another important relative advantage for alternative energy cars is fuel efficiency. Therefore, manufacturers should emphasize the fuel savings advantages to attract consumer's attention. The demographic variables do not play a significant role in influencing the consumer's car buying decision. Only gender is significant with male consumers more willing to purchase hydrogen powered cars. However, in the univariate analysis, younger, higher income and better educated consumers have a higher propensity to buy the alternative energy cars indicating a potential target groups for manufacturers.

Fuel efficient vehicles will be the next generation vehicles and many manufacturers are currently in the process of testing and developing new vehicles. However, the popularity of alternative energy cars will be influenced by the consumer's adoption attitudes toward the innovations. This study outlines the factors that affect consumer's decision on purchasing alternative energy cars and serves as a reference for marketers in developing sales strategies.

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Appendix 1. Description of the questions in the survey about hydrogen and the corresponding dimensions

	Questions in the survey	Corresponding dimensions
1	To what extent do you think that hydrogen fuel has advantages over gasoline?	Relative Advantage
2	To what extent is the use of hydrogen fuel compatible with your values?	Compatibility
3	To what extent is use of hydrogen fuel a complex issue?	Complexity
4	How risky is the use of hydrogen fuel?	Perceived risk
5	How likely is it that you will know if your friends are using hydrogen fuel in their cars?	Observability
6	How likely would you be to try hydrogen fuel when it is available at your filling station?	Trialability

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EXCEL COURSE MANAGER (ECM): AN ELECTRONIC CLASSROOM MANAGEMENT SYSTEM DESIGNED FOR CREATING AND GRADING EXCEL ASSIGNMENTS AND EXAMINATIONS

Dr. James K. Fugate, Texas A&M University - Corpus Christi, USA
james.fugate@tamucc.edu
Dr. Chuleeporn Changchit, Texas A&M University - Corpus Christi, USA
chuleeporn.changchit@tamucc.edu
Dr. Robert Vokurka, Texas A&M University - Corpus Christi, USA
robert.vokurka@tamucc.edu

ABSTRACT

Due to rapid advances in technology, computers have enabled substantial benefits to all fields of education. Instructors teaching spreadsheet applications such as Excel are faced with a variety of assessment and teaching methods to assign and grade homework projects that guide students in mastering the essentials of spreadsheet operations. Several grading software packages are available in the market to increase the efficiency and effectiveness of teaching an Excel course. This study discusses a system designed to create and grading Excel assignments. The system advantages and drawbacks are discussed and compared to those packages available in the market.

Keywords: Teaching Innovation, Software applications, Grading Systems, Excel Spreadsheet

INTRODUCTION

We can now look back to the beginning of the digital era and say that both the technological advancements and the human-computer interface have brought the education field new opportunities in the development of computer-based teaching and tutoring systems (Raineri, Mehrtens, Hubler, 1997). In modern education, computer applications are capable of enhancing the quality of teaching and learning. The technological revolution provides much faster facilities to access source of information and allows educators to provide instant feedbacks to students. In order to maintain such standards with the ever changing environment, it has become necessary for educators to revise their traditional methods of teaching and take advantage of the technological tools available so that a more productive and interactive course can be offered to students (McDermott, 1990, 1993). New curricula must be developed in order to adapt and better challenge students with various backgrounds and implicitly different means of learning (Raineri, Mehrtens, Hubler, 1997).

Aside from teaching, assigning homework and the grading process are significant tasks for most, if not all, educators. Going through assignments, tests, and other evaluations is time consuming, especially with large classes with more than 100 students (Friedler, Tan, Peer, Shneiderman, 2008). Nevertheless, grading thoroughly and constructively is important to the learning process. Students perceive grading as an effective assessment and thus it is viewed as an integral part of teaching and learning rather than being apart from a curriculum (Garfield, 1994). As the course progresses, instructors are required to pinpoint program weak points so that students who have difficulties in a particular area can be identified and help can be provided (Friedler, Tan, Peer, Shneiderman, 2008). Any tool or technique that can make grading easier helps educators identify and understand students' struggles and successes so

that above average students can be challenged and below average students can be helped (Friedler, Tan, Peer & Shneiderman, 2008). Hence the recognition to which an effective grading system can serve as a crucial tool to improve teaching and educational methods.

Although many educators have used automated grading to assess and provide quick feedback for a large number of students, there are few studies on automated grading and specifically for Microsoft Excel. This paper aims to introduce an alternative automated grading program for Excel in comparison to other known automated grading programs. Descriptions of these existing programs are provided, and a further detailed explanation of what they specifically target is discussed.

This article introduces a system which has been actively used in business computer classes at Texas A&M University - Corpus Christi. Students are required to submit an assignment every week. The use of the program reduces substantially the amount of time in grading the assignments, gives instant feedback, and provides enough flexibility to ensure the most accurate assessment.

BACKGROUND OVERVIEW

Prior to the use of computers, grading was a time-consuming and labor intensive process. Most educators spent between one-third and one-half of their time on grading students' assignments (Stiggins, 1999). Assessment was done entirely by hand or with the assistance of a calculator (Migiorino, 2002). Although the approach to grading by hand can vary if comparing the grading process of a program assignment versus an essay assignment, there is still a consistent element towards the human factor that fails to support such traditional systems. Within program assignments the human factor is considered inconsistent, dependent on the humor and vigilance of the grader. An exact same program when graded by different human graders most generally results in different grades (Cheang, Kurnia, Lim, Oon, 2003). To this extent, even when essays are recognized as being the one of best means to evaluate the performance of students, the subjectivity of the grading process raises difficulties in the attempt to produce consistent grades among different human evaluators (Valenti, Neri, Cucchiarelli, 2003).

Microsoft applications are being used widely in broader purposes, including grading systems. Among the automated grading programs developed to help instructors in Microsoft Excel and Microsoft Office Application are SAM – skill assessment training manager - (Thomson Learning/Course Technology) and MEAGER - Microsoft Excel Automated Grader (Hill, 2003). The overview of these systems will be provided in the next section.

Automated Grading Programs

Automated grading programs can be defined as a part of computer aided assessment (Tshibalo, 2005). The popularity of the computer aided assessment technologies rises significantly as the number of student increases. Previous research suggested that automated grading provides consistency, thoroughness, and efficiency (Isong, 2001). For example, among programming courses this benefit allows the assignment of more programming exercises for students since the automatic grading avoids any possible errors that can occur with human grading (Cheang, Kurnia, Lim, Oon, 2003). One of the major advantages of automated grading is that students receive timely feedback on their performance (Shah,

2003). Wang et al. (2006) suggests that benefits of automated grading are giving marks objectively, improving students' learning experience, and reducing the workload for instructors.

The early research of computer aided grading programs evolved in computer science classes. The early automatic grading prorams were used to evaluate student's problem solving skills in computer science (Wang et al., 2006). Many grading programs in this field include ASSYST system (Jackson & Usher, 1997), PGSE (Jones, 2001), Virginia Tech's Curator System (Edwards, 2003), GUI_Grader (McAllister & Feng, 2005) and Marmoset (Spacco, 2006).

Some programs are designed especially for essay assessments. Many studies have been conducted to validate the viability of using computer technology to grade short essay of English prose (Landauer, Laham & Foltz, 1998, Shermis et al., 2002; Yang et al., 2005; Dikli, 2006). Brent (2004) introduced Qualrus to automatically grade essay of students in an introductory sociology class (Brent, 2004). In addition, automated grading is also popular in other areas. For example, Beevers & Jackson (2001) suggested Mathwist to assess mathematics skills in engineering courses.

Microsoft Excel Automated Grader

Among the grading systems for office applications is SAM (Thomson Learning/Course Technology). SAM is a system of evaluation for Microsoft Office which requires students, on a time controlled basis, to conduct a series of tasks on a computer using the pertinent software. It evaluates a student's skill by asking him/her to perform specific activities and then measures his/her performance in that application (Whittle, 2005). A student conducts his or her assigned requirements on the computer. Then by recording the students' movement used with the mouse and keyboard in response to the tasks assigned, the system grades the students' performance in an Office XP environment (Whittle, 2005). When these are compared against the instructors' correct proceedings, grades are given based on the results (Hill, 2003).

MEAGER is another program used for skill assessment that, unlike SAM, more specifically evaluates students' skill on Microsoft Excel through statistical analysis on Microsoft Excel spreadsheet. The focus of the tool is on the end results that arise after the student's workbook is turned in, not on the steps he/she conducted to perform the assigned tasks. Since MEAGER is designed to grade assignments accurately in every detail, the program compares students' work with the instructor's correct version (Hill, 2003). It requires students to input the same exact format as the instructor provides in each cell (Hill, 2003). As a result, the program is not flexible, although it enables the instructor to see the score as soon as the assessment is completed (Hill, 2003).

Generally, for Excel-based courses instructors assign students to perform a number of tasks in a given workbook. When such workbooks are compared to the instructor's correct version, the differences are what define the errors and therefore the grade. MEAGER conducts this same comparison automatically grading from text labels, formulas, number formats, to cell orientation and even cell fill color among other characteristics. However, it has limitations for grading charts, embedded objects, drawing objects and controls (Hill, 2003). The assignment of the grade is derived by the taking the characteristics from both the instructors' correct

workbook and the student's workbook into MEAGER's system tables identified as Cell, Format, Border, Formula, Row, Col, and Worksheet (Hill, 2003). With the comparison of these characteristics, the system detects any errors and records them in an errors table (Hill, 2003). At the bottom of the worksheet, the number of errors encountered and the numbers of points reduced are shown in a grade summary.

The particular benefit of this assessment tool is a much more explicit evaluation than given by a human grader since the program emphasizes grading characteristics that may be missed by the human eye. Details such as alignments, column widths, row heights, number formats among others are many that MEAGER evaluates with greater detail (Hill, 2003). Further more comprehensive criteria can also be graded making it possible for instructors to fully cover various areas of the course that previously were difficult to evaluate given the tedious and time consuming task that it presented for the instructor. Without a doubt the use of MEAGER is timesaving, leaving the instructor only to define the seriousness of the errors listed.

Further benefits of MEAGER are the reports it generates after comparing a group of students files with that of the instructor. MEAGER can generate three reports: Grade Report, the Errors List, and the Common Errors report. The first contains the grade of each individual Excel file evaluated. The second provides an insight into all the errors detected among the group evaluated. The third report lists the common errors among the students evaluated by examining two student files at once, further helping the instructor in visualizing the key areas in which greater practice is required. This also provides the capability to the instructor to detect plagiarism among students since common equal errors listed among two student files may be a sign of possible plagiarism.

Despite all its benefits, no system is without weaknesses. Among the weaknesses of MEAGER is that it requires all student files be gathered at one time into one folder (Hill, 2003). This is not always possible, since some students may submit their work via email attachments or other electronic means making the gathering process slightly inconvenient for the instructor in order to initiate the grading process. Another recognized weakness is the abundant markings of its grading process (Hill, 2003). Given that the instructors' file serves as the control file for the correct base grading, any markings other than those included in the instructor's file is considered erroneous. Examples of this type of excess markings are a student including extra spaces in a label or if a student has even small differences among column height or width (Hill, 2003). Furthermore since MEAGER is in a beta release, if it finds an error in a file it will automatically continue grading the next file and leave the previous file with a grade of -1. This obligates the instructor to interpret the error of the file and go into the file to further grade it by hand (Hill, 2003).

eMarkbook Excel Template

Another assessment tool is known as the eMarkbook Excel Template. The approach of this timesaving tool is entirely different in comparison to MEAGER or SAM. Its primary function is to help instructors better manage student scores. Although developed on a Microsoft Excel based template, it does not offer the automatic grading of students' assignments in comparison to that of the instructor. It only manages student grade data and therefore offers instant updates of the students' grades individually as well as multiple classes of any given course (Watson, 2008).

The data is entered using a main sheet known as Class Marks (Watson, 2008). As the instructor inputs the grades of an assignment or exam the system automatically updates the grades, percentages and averages among students evaluated in the given group (Watson, 2008). Instructors are given specific cells within the sheet where they can introduce the data. The rest of the cells are blocked to avoid errors that may disrupt the formulas they contain, therefore updating instantly (Watson, 2008).

The system offers many functions including Rank/Print, that allows instructors to sort students into groups or rank students in individual classes and later generates a summary of their respective marks (Watson, 2008). Other functions include separating and delete the scaling of groups of marks, functions for printing, and emailing among others (Watson, 2008).

Although there are many alternatives from which to choose for grading and giving back a written online assignment, each modality has its benefits and pitfalls and it depends on the inclination of the grader as to which one to select (Jennings and McCuller, 2004). However, with the availability of a number of software applications, educators can reduce considerably the amount of time required to grade all students (Migiorino, 2002). In addition to the time saving factor, such support can allow instructors to offer students an enhanced learning experience with more objective evaluations and immediate responses (Tiantian, Xiaohong, Yuying, Peijun, 2006).

The system developed in this study has been actively used in business computer classes at Texas A&M University - Corpus Christi. Students are required to submit an assignment every week. The use of the program reduces substantially the amount of time in grading the assignments, giving instant feedback and provides enough flexibility to ensure the most accurate assessment.

EXCEL COURSE MANAGER (ECM)

The Excel Course manager (ECM) is developed as an Excel application. The application is placed inside a folder named “XCL”. This folder contains a “CourseManager” subfolder and other subfolders for each class section. For instance, if the class has two sections, two subfolders will be generated and named “CourseExcel001” and “CourseExcel002”.

For each section subfolder, two subfolders are created to contain a Project (Assignment) Template and Key for each Project. These subfolders are named as “ProjTemplates” and “ProjKeys”.

Project Template Folder

This folder contains Excel files for projects/assignments. Each file is named as Template + class number + section number + project number. For example, the file for project 1 for the class Excel, course/section 001 is named as “TemplateCourseExcel001Proj1.xlsx”

The template file contains several worksheets with instructions for a student to complete the assignment. Figures 1 and 2 below show examples of the first and the second worksheets for Project 1:

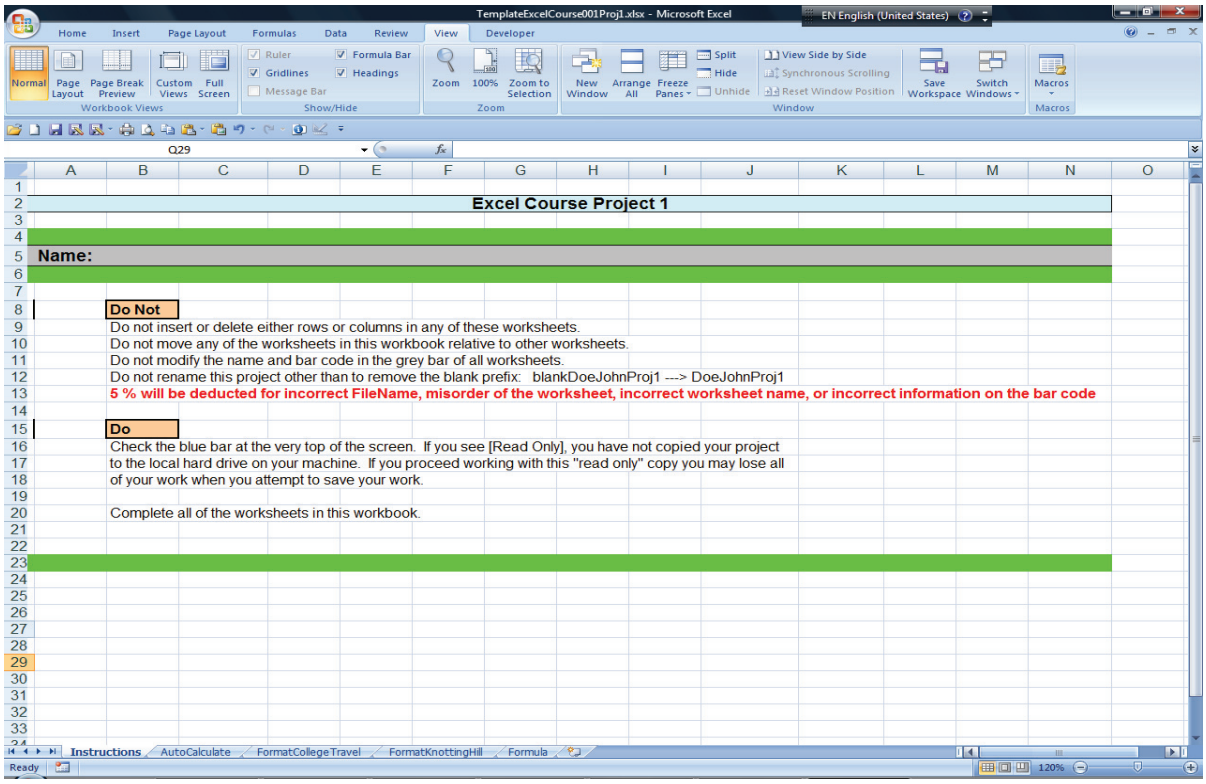

Figure 1: Template Instruction for Project 1 (First Worksheet)

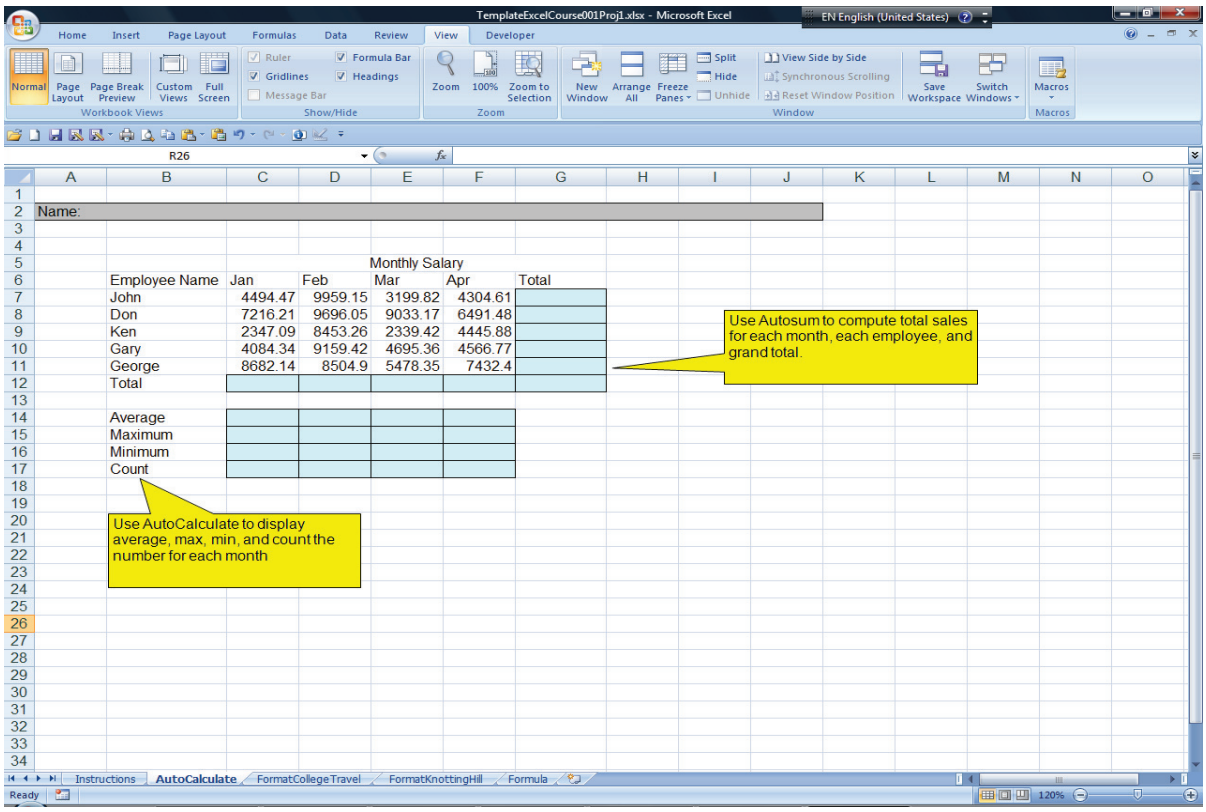

Figure 2: Template Instruction for Project 1 (Second Worksheet)

Project Key Folder

This folder contains Excel files solutions for projects/assignments. Each file is named with Key + class number + section number + project number. For example, the file for project 1 for the class Excel, course/section 001 should be named as "KeyCourseExcel001Proj1.xlsx" The Project Key files contain worksheets matching the Templates with all work completed. These keys are Excel workbooks which contain all data and all computations that students need to do to complete the project. These keys can easily be modified to suit the requirements of any particular Excel class. Projects can be customized by adding or deleting worksheets, or changing the work to be done within an existing worksheet. Figure 3 below show examples of the key for the second worksheets for Project 1:

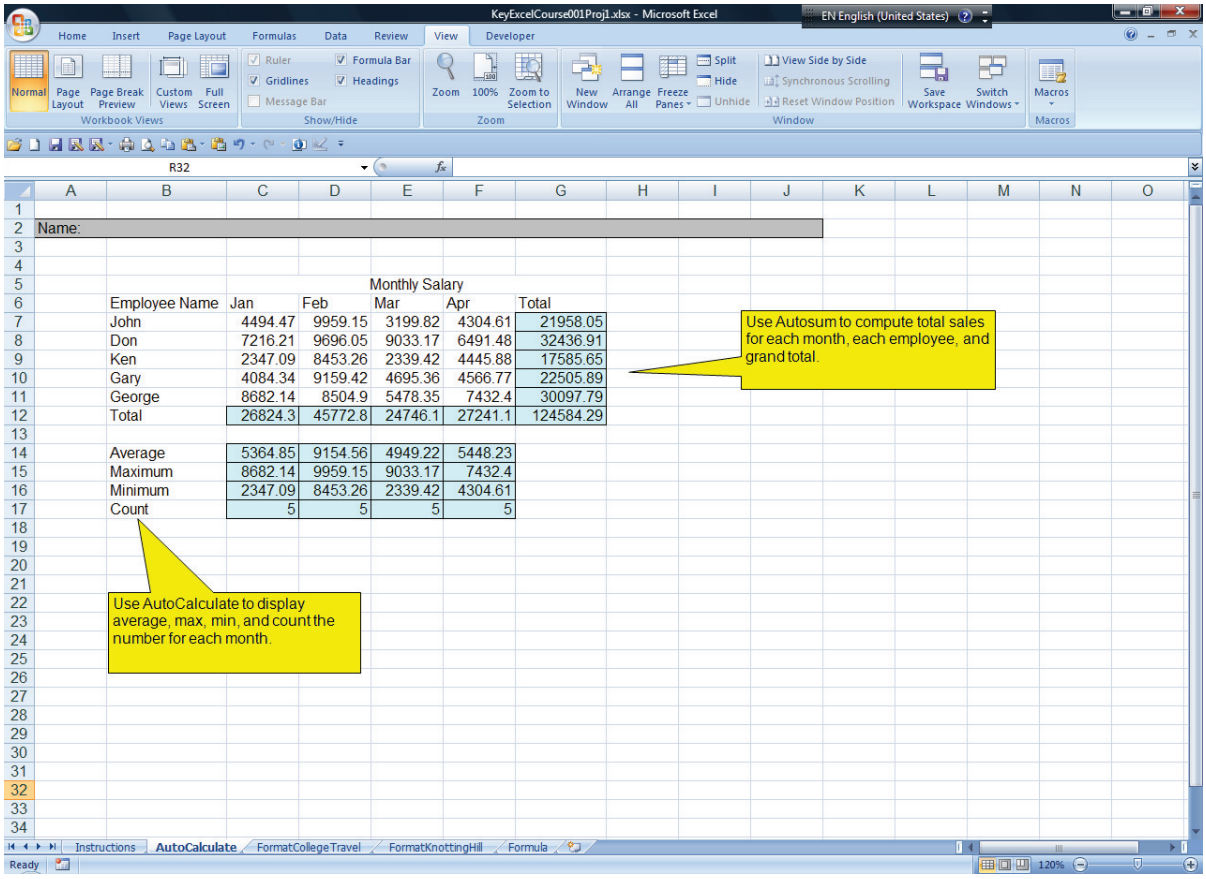

Figure 3: Key for Project 1 (Second Worksheet)

At this point, you may notice the name grey bar on the top of each worksheet. The purpose of this grey bar will be explained in a later section.

Course Manager Folder

This folder contains an Excel Macro-Enable file named "CourseManger.xlsm". The Course Manager file consists of the "Course Manager Console" and course worksheets (Usually name with course and section name, e.g., CourseExcel001 and CourseExcel002). The course

worksheet contains student roster and scores. Figures 4 and 5 below show the Course Manger Console worksheet and CourseExcel001 worksheet:

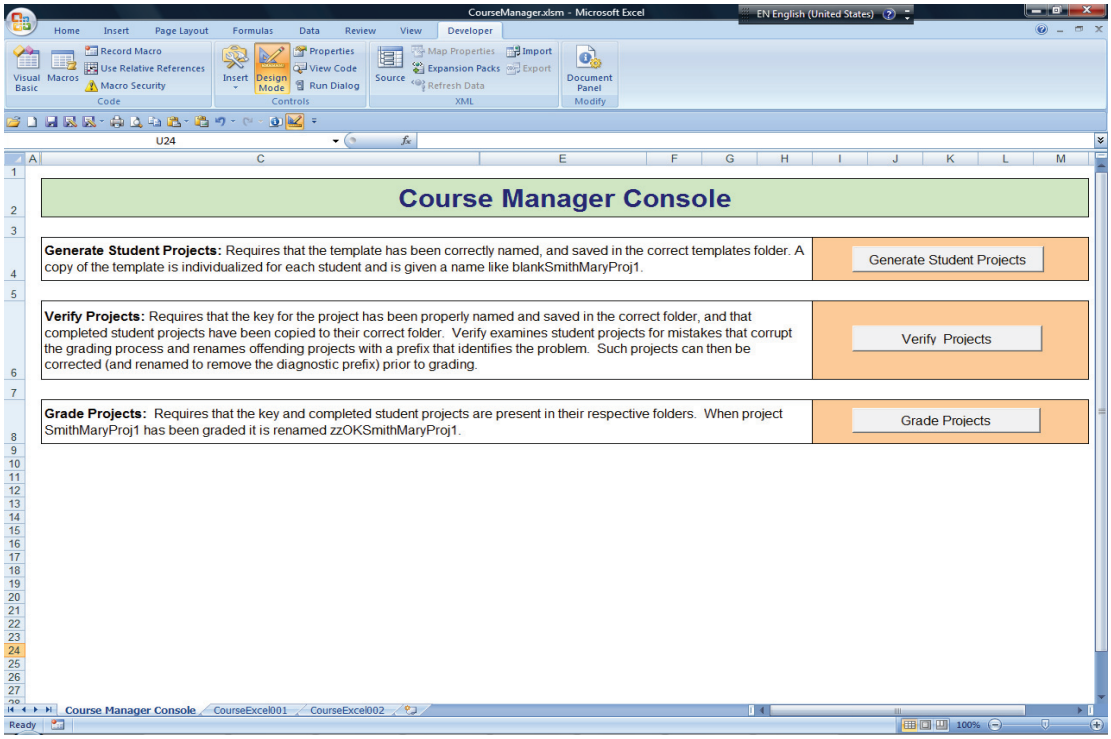

Figure 4: Course Manger Console

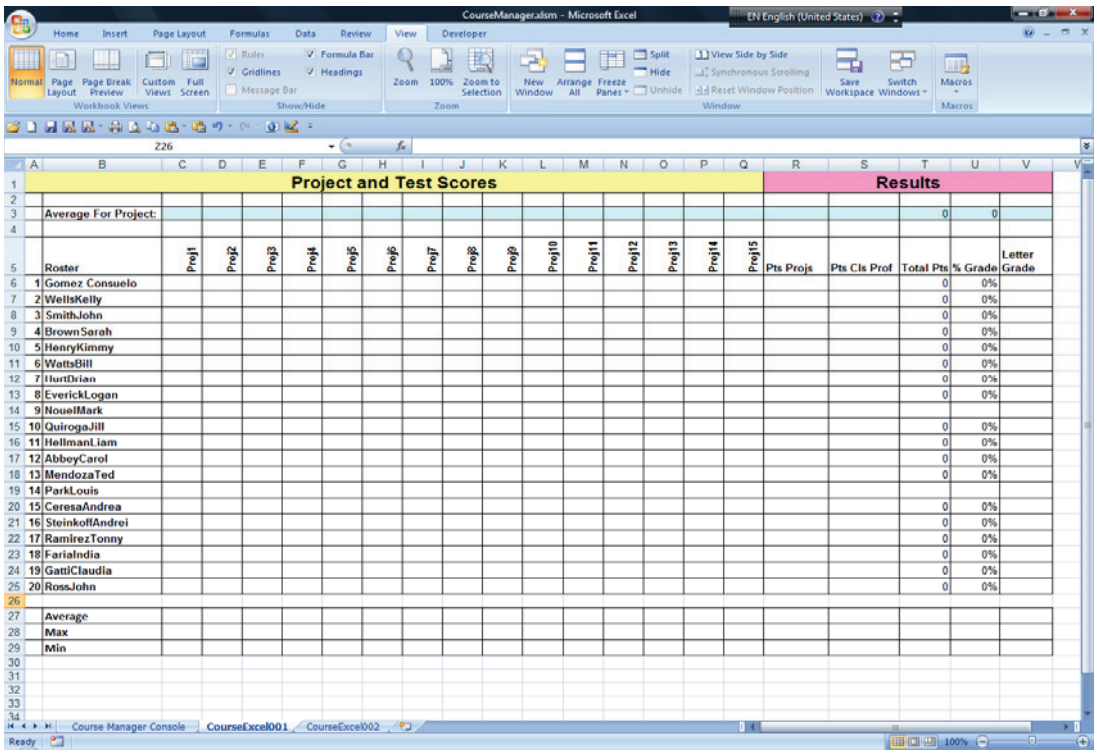

Figure 5: CourseExcel001 Worksheet

The Course Manger Console Worksheet contains three Control buttons: (1) Generate Student Project, (2) Verify Projects, and (3) Grade project.

(1) Generate Student Projects Control Button

Before generating a project, the instructor creates a subfolder within the course folder with using the project number as the name of the subfolder. For example, the name for project 1 subfolder should be named as "Proj1"

When the instructor chooses the control "Generate Student Projects" button, a "Generate Student Project" screen will be pop-up so that an instructor can choose which class and which project should be created (see Figures 6 and 7 below). An individualized copy of the chosen project is generated for each student listed in the roster for the chosen section. These files will be placed inside the "Proj1" folder. Each file is automatically given names like blankDoeJohnProj1.xlsx and the student's name is also placed at the top of each worksheet in the workbook along with a "bar code" to help curtail copying the work of others. The prefix "blank" is added to distinguish projects that have not yet been worked on. The instruction will be given to students to rename the file by removing prefix "blank" once they complete the project.

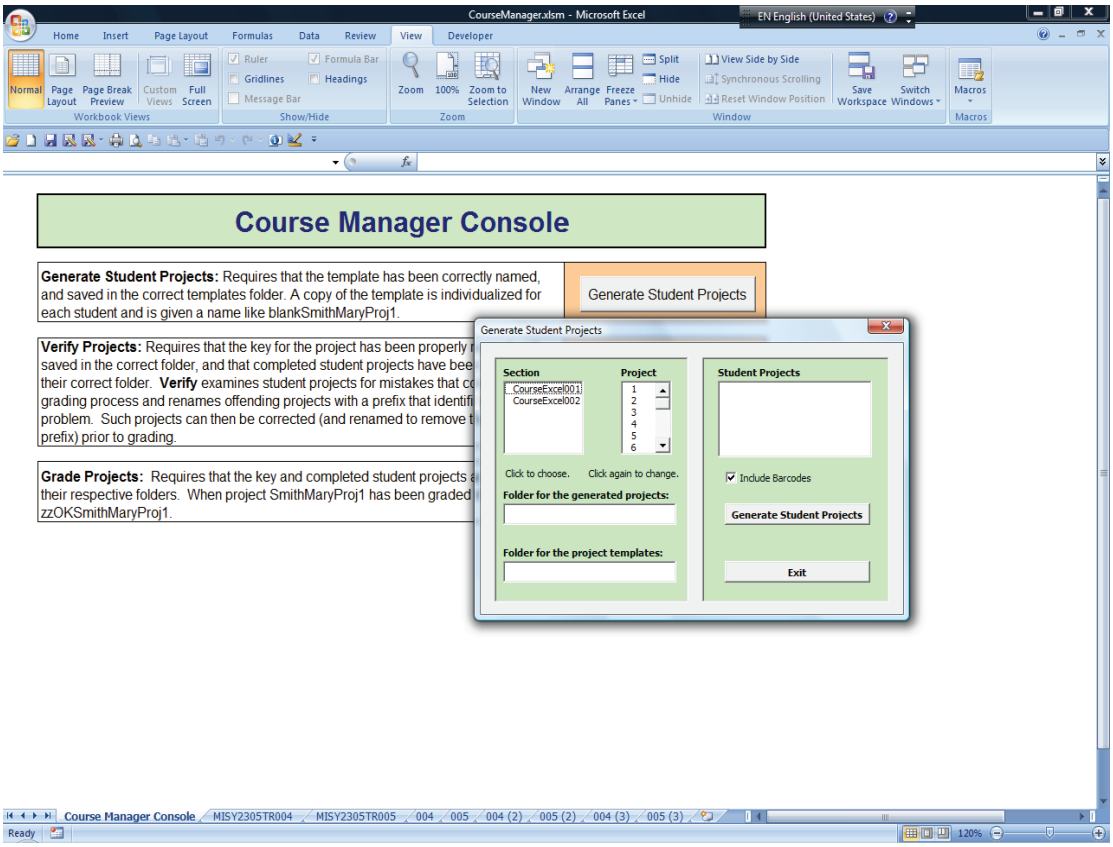

Figure 6: Generate Student Project Pop-up Screen 1 (before generate)

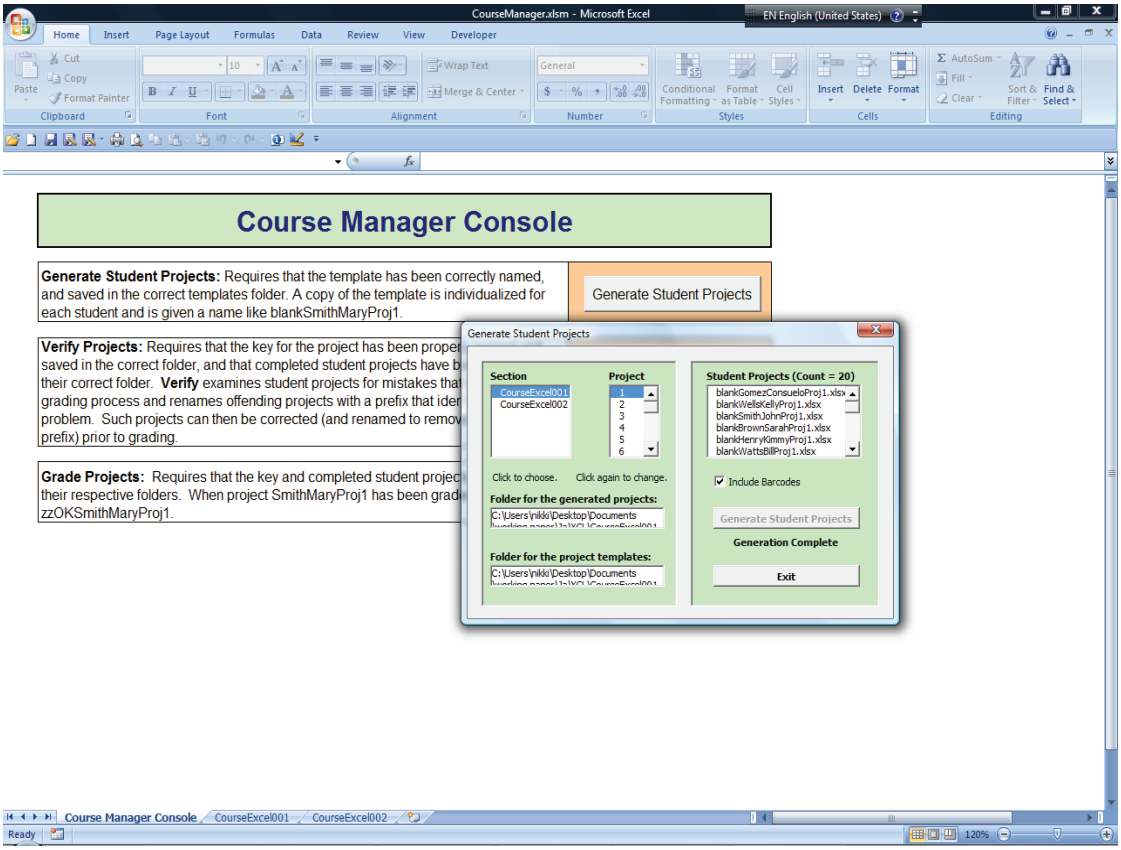

Figure 7: Generate Student Project Pop-up Screen (after generate)

(2) Verify Projects Control Button

Before projects are graded, it is helpful to trap irregularities. Pressing Verify Projects determines whether any of the following are present. (1) File name does not match a name in the roster. (2) Project number is incorrect or missing or "Proj" is not a part of the file name. (3) Student project cannot be opened because the workbook has somehow become corrupted. (4) Incorrect number of worksheets in the student workbook. (5) The order in which the worksheets appear in the student workbook is not the same as the order in the key. The verification process does not alter the student project except to rename the project with a diagnostic prefix. If, for example, John Doe changed the order of the worksheets within the project, the file name DoeJohnProj1.xls would be automatically changed to zz~TabOrderDoeJohnProj1.xls.

(3) Grade Projects Control Button

When an instructor chooses the control "Grade Projects" button, each student project will be graded against the project key. The grading system requires that the "ProjKeys" folder contains a file "KeyCourseExcel001Proj1" and that "Proj1" folder contains the student project to be graded, e.g., SmithMaryProj1".
When student projects are graded, the project key is opened in order to provide information for the grading process. To understand what follows, the term "selection" as it applies to a worksheet should be discussed. An instructor will select "Grading Cells" by clicking on specific cells. These selected cells will become the selection.

More than one cell can be selected either by holding down the left mouse key and dragging or continuous cells or by pressing the Control key while dragging for non-contiguous cells to become the selection. Each worksheet within the workbook can have its own selection of cells, and these will be saved when the workbook is saved.

The selection process allow an instructor to grade only cells that contain formulas or functions that he or she selects to test students' knowledge instead of grading the whole worksheet. For example, not all worksheets within a workbook will necessarily be graded; worksheets whose tab names are like Introduction or ScratchPaper would not be. Worksheets like this will not be graded when the selection saved with them contains just a single cell. If the selection contains more than a single cell, the corresponding worksheet in the student project is graded. When a multiple selection is present, just the individual cells within the selection are graded. This allows the instructor to choose representative cells within the worksheet to grade and avoids the redundancy and confusion of grading every cell within the worksheet.

If a cell to be graded in the key contains a formula, then the corresponding cell in the student project must also contain a formula (and the formula must compute the correct answer) for the student to earn points for that cell. Of course there will typically not be just one correct version of a formula. The issue here is whether or not the key has a formula at all in the cell to be graded. If the key does not have a formula in the cell to be graded, then the student project need not have a formula in the corresponding cell.

By default, the software assigns a point value of five for each correct cell in the student worksheet. If a particular worksheet contains cells which should have some other point value, the corresponding project key worksheet would contain "CellPoints = 3" as a label located somewhere in column A.

Also, by default the grading process assumes that formatting will not be graded on a particular worksheet. Otherwise, the corresponding worksheet in the project key contains "FormatPoints = 30" as a label located somewhere in column A. Each corresponding worksheet of the student project is automatically made visible to the instructor. The instructor visually assesses to what extent formatting is correct and then assigns a grade by clicking in a small window temporarily made visible for that purpose. Other aspects of the worksheet can be graded visually as well. If a particular worksheet contains an embedded graph, a macro button, or some other feature, the corresponding worksheet in the project key would have "OtherPoints = 20" located somewhere in column A. Once again, the grading process automatically makes such worksheets visible so that these features can be viewed or tested. As before, a small temporary window allows point values to be assigned. Printing can be graded this way as well. If a particular worksheet should have been configured for printing, putting a label like "Other Points = 30" will cause this worksheet to be visible. The instructor can then choose "Print Preview" to assess how the printed report would have looked. In a similar way a worksheet can be designated as extra credit by including a label like "ExtraCredit=20."

When all point values are assigned (either by the instructor or by the automated grading process), the total possible points and points earned by the student are computed. The percentage grade is automatically entered in the roster.

The graded student project is altered in the following ways. If the student has the correct answer in a graded cell, that cell is given a green background color; if the answer is wrong, the background color is set to red. In either case, the content of the cell is not changed. The grading process also records a page score on each page of the student project, as well as a cumulative project score on the Introduction page of the project.

When the student project is graded, it is renamed zzOKDoeJohnProj1. These naming prefixes allow blankDoeJohnProj1, DoeJohnProj1, and zzOKDoeJohnProj1 to be simultaneously stored in the same folder. The naming prefixes also prevent confusion among these three versions of the student project.

DISCUSSION

The ECM has been used for teaching Excel classes for over 15 years. The experience using the system has been very positive. The ECM minimizes the time an instructor needs for generating and grading assignments. The average time used for grading a project (for 40 students) is approximately 10 minutes. If the templates and keys are designed properly, the accuracy of grading is very high.

Compared to other Excel Grading Systems available in the market, the ECM contains several features that differ from others as follows:

- The ECM is independent of any particular textbook. Unlike other systems that provide an instructor with fixed templates and keys, the ECM allows an instructor to create his/her own files to test appropriate knowledge taught in the class. Several model templates come with the ECM system. Since these model templates can be modified as needed, it is not necessary for an instructor to create templates from scratch. Courses have been successfully taught with ECM using no textbook at all.

- An instructor can select any desired set of cells for grading, which avoids the redundancy of grading every cell.

- The ECM can grade not only cell contents such as numbers or formulas, but also allows for format, the operation of macros, or the correctness of printing to be graded visually. In addition any of the worksheets within the project workbook can be designated as extra credit.

- The ECM automatically individualizes projects by including students' name and a unique bar code at the top of each of the worksheets, thus preventing students from copying files from their classmates.

Although the ECM provides several benefits as mentioned above, it is also important to note its system limitations. In order to maintain the capability of grading a student project, students need to be careful while working on the project. For example, students cannot insert

or delete any rows or columns. (The projects have been designed in such a way that inserting or deleting is never necessary.) Students cannot reorder the worksheets within the workbook (by dragging the worksheet tabs to a different location) or give the worksheets a different name (by changing the name on the tab). Students cannot protect worksheets as this would disallow the changes made to their worksheets in the grading process. Otherwise all design capabilities within the spreadsheet environment are allowed.

Currently, the ECM has been developed to be independent of the Internet. The system works best in a classroom in which all students can log onto a network (either LAN or otherwise) so that the projects can both be submitted to the students, and received back from the students electronically. Future research can be conducted to develop the system to be Internet-based application.

CONCLUSION

With rapid advances in technology, it is obvious that potential employers will expect students to graduate with good computer skills. Since Excel is widely used in most organizations, it is very important that students are familiar with Excel applications. Typically, with hands-on class settings, the more students are required to practice with assignments, the better they learn and develop skills. Nevertheless, the impracticality of manually grading such a volume of assignments, especially when the class size is larger than 40, usually creates a tendency for the instructor to assign less homework than would be ideal for the learning goals of the class. The systems described here help minimize this problem by reducing the grading burden to minutes instead of disheartening hours. On an average, it takes approximately ten minutes to grade an assignment consisting of five worksheets for 45 students.

Currently, quite a few attempts, both from publishing companies and developers, have been conducted to develop systems accompanying Excel textbooks which allow for automatic grading of assignments and/or tests. These systems are aimed at reducing times and perhaps increasing the accuracy over an instructor manually grading Excel assignments. Since these systems have different capabilities and limitations, some will fit a particular way of assessing this work better than others. However, these systems are usually customized as they are designed to accompany a specific textbook. There is very little allowance, if any, for an instructor to change the design or develop his/her own worksheet templates. Different from these systems, the ECM was developed to allow for more customization. In fact, two instructors can assign completely different sets of assignments and/or tests using the ECM. An instructor has total flexibility in terms of the design of his/her own worksheet templates and the selection of which cells or knowledge they would like to select for grading.

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DEVELOPMENT STRATEGY OF SERVICE INNOVATION: NEAR FIELD COMMUNICATION SYSTEM APPLICATION

Dr. Tsui-Yii Shih, LungHwa University of Science and Technology, Taiwan
tsuiyii@mail.lhu.edu.tw

Graduate student, Chia-Chang Chan, LungHwa University of Science and Technology, Taiwan
G962201003@ms.lhu.edu.tw

ABSTRACT

The NFC (Near Field Communication) system has recently gained broad attention by the service industry. Service firms actively develop and expect NFC to have broad applications in the consumer market. The research applies the technology acceptance model (TAM) and innovation diffusion theory (ID Theory) to develop the conceptual framework and then discusses consumer attitudes and adoption behaviors concerning the NFC system applications. The discussion on factors in the research include perceived usefulness factor and perceived ease of use factor from the TAM model; and the compatibility, complexity, trialability, observability, and relative advantage, factors from innovation diffusion theory. Research results verify that specific factors of the TAM model and ID theory model could positively affect the NFC adoption attitude of consumers. Furthermore, when consumers have good adoption attitudes toward innovation technology, then consumers' adoption behavior concerning NFC systems will be effectively improved.

Keywords: TAM, innovation diffusion theory, Near Field Communication

INTRODUCTION

In Taiwan, due to the popularity of information applications (e.g. internet, computer and wireless applications), prevalence of cell phone, as well as the pursuing innovation in the life characteristics of Taiwanese people, there is a growing population of consumers who have higher high technology knowledge and expect innovation technology products, thus, the high technology and service firms in Taiwan are forced to improve constantly. The digitalization of cellular phone has brought an important influence to the Taiwan cellular phone industry. After applying NFC (Near Field Communication) security mechanism to the privately cellular phones, the security of mobile payment is highly enhanced, and the digital transactions become more convenient for the consumers.

Understanding factors that influence consumers' intentions to use or reject information and

communication technologies (ICT) is an interest topic. As new ICT continue to develop at a rapid pace, understanding these factors is important [39]. In the context of mobile commercial environment, numerous scholars have employed technology acceptance model (TAM) and innovation diffusion theory (IDT) as a base model, to investigate the use and acceptance of a mobile technology (e.g. [8]; [24]; [31]). TAM posits that behavioral intention determines actual systems use and behavioral intention is determined by both attitude and perceived usefulness. Perceived usefulness and perceived ease of use both affects on behavioral intention [37]. Further, innovation Diffusion Theory (IDT) (including the compatibility, trailability, observability, complexity, and relative advantage factors) has also been widely used for relevant IT and IS research ([20]; [13]).

By adopting an integrated perspective emphasizing the roles of TAM and ID theory, this paper addresses these key gaps by developing empirical NFC service development strategy explanations for related service innovation products application research in terms of a linear regression method. The objective of this study is to investigate and evaluate the TAM model and ID theory and to examine their importance in allowing service industries to design a development strategy of service innovation products (e.g. NFC system service) in the commercial marketplace. The findings have the potential to offer significant implications for theory and practice. In addition, it may also give some insights into related academic research in the future. The study includes developing a questionnaire that builds from the following conceptual framework (See Figure 1). The rest of the paper is organized as follows. Section 2 gives a review of the literature in the areas of TAM, ID theory, and use intention. Section 3 introduces the methodology used in the research. Section 4 presents the background of data sources and analysis and gives the research findings of the study. Finally, section 5 provides the discussion and conclusion.

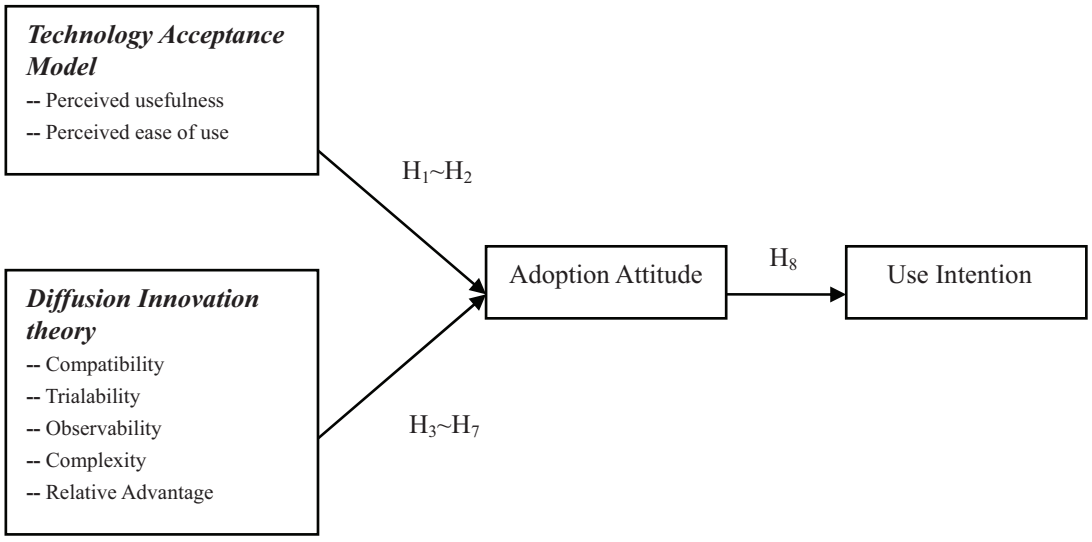

Figure 1. Conceptual framework

LITERATURE REVIEW

Previously, an NFC Service application in TAM and ID theory has not yet been explored. Therefore, this study aims to add to the limited literature on NFC Service, mainly in Taiwanese context. This section outlines literature reviews of former scholars and defines a theory base for this study.

Application of NFC System in Service Industry

NFC is a short range wireless technology that is quickly becoming the technology of choice by handset manufacturers, credit card companies and public transport operators around the world for contactless transactions including secure payment and ticketing [19]. NFC is an interconnection technology that enables secure short-range communication between electronic devices, such as mobile phones, PDA, computers and payments terminals via a fast and easy wireless connection [19]. According to a new research study from ABI Research, more than 419 million NFC chipsets will ship in 2012. NFC chipset shipments and revenue will continue to grow steadily over the next several years [15]. Several NFC applications are promising, including transit ticketing and payment. For example, in 2007, the initial UK contactless rollout in London proves a bellwether for the technology in Europe, NFC rollout is supported by the widespread adoption of contactless transportation and payment systems [16].

In Taiwan, the first NFC mobile co-branded transit card has been issued in cooperation with several companies, including ChungHwa Telecom, Master Card, and the Farglory Group. This corporation activity provides 6000 NFC mobile phones for the Farglory Group's architectural buildings. These NFC mobile phones have Easycard and Digitalhome equipment control functions. Furthermore, ChungHwa indicates that they will continue to develop NFC communication services, such as virtual shopping, E-guide, automatic download certificates, and other added service values in the near future. In academia, scholars have described the development of an NFC service instrument designed to measure user perceptions of adopting an information technology (IT) innovation [25]. While the decision to use IT service products and the key success factors behind IT products adoption and use intention have been the focus of a considerable number of studies worldwide, the examination of the use behavior of Taiwanese consumer has been limited. In addition, research in divergent socio-cultural settings, and different economic times yield conflicting results in relation to many of the factors hypothesized to impact on consumer adoption behavior of IT service products. Thus, an examination of the Taiwanese consumer for NFC mobile payment system is a worthwhile pursuit.

Application of Technology Acceptance Model on Innovation Service Products

According to the technology acceptance model an individual's behavioral intention to use a technology can be explained by their perception about the usefulness of the technology in question and their attitude towards technology use ([10]; [30]). TAM was adapted form the TRA [2] to understand the causal chain linking external variables to technology usage intention and actual use in a workplace [26]. The key purpose of TAM is to trace the impact of external variables on internal beliefs, attitudes, and intentions. The TAM suggests that two factors – perceived ease of use and perceived usefulness – are the two main factors in explaining system use [11]. According to the model, acceptance of technology depends upon user perceptions of the technology's usefulness and ease of use. These perceptions in turn affect user intentions to apply the technology at high levels and on a basis into the future [4].

In academia, scholars have applied TAM model to predict and suggest the application or promotion of new technoloogy. Many study findings indicate that these two constructs are useful and valid in evaluating consumers' intention to use information system (IS) (e.g., [3]; [8]; [9]; [28]). For example, Fang, Chan, Brzeinski and Xu (2005) suggested that under wireless PDA context, user intention to perform general tasks is influenced by perceived usefulness and perceived ease of use [12]. A study of consumers' adoption of a mobile system in Finland found that perceived usefulness among research factors played an important role in consumers' intention to use the mobile system ([17]; [31]). Further, Bhatti (2007) suggest that perceived usefulness, perceived ease of use and behavioral control are strong determinants of intention to adopt mobile commerce [6]. In the broad context of smartphone acceptance, mobile services can be available at any time and any place. Thus, perceived usefulness is defined as how well consumers believe mobile services can be integrated into their daily activities ([21]; [31]). In sum, from the above discussion about TAM factors on IT service products, the following relationships are hypothesized:

H_1: Perceived usefulness of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.
H_2: Perceived ease of use of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.

Application of Innovation Diffusion Theory on Innovation Service Products

The diffusion of innovation theory is as a theory of communication which has been studied extensively in the literature and with respect to different types of products and services ([5]; [7]; [25]; [36]). Innovation Diffusion Theory (IDT) is defined as 'the process by which an innovation is communicated through certain channels over time among the members of a social system [34]. It has been widely applied in disciplines such as anthropology, sociology,

education, communication, marketing, etc ([13]; [36]; [42]). The perceptions of adopting were initially based on the five characteristics of innovations derived by Rogers (2003) from the diffusion of innovations literature [36].

The factors in ID theory model include compatibility, observability, trialability, complexity and relative advantage. Comparability is related positively to its rate of adoption. The more an innovation is recognized as compatible with the system, the more it would be adopted [22]. Trialability would positively affect the user adoption. Rogers (2003) suggested that if a trial is permitted, adoption and implementation will be easy and quick [36]. Observability would positively influence the user adoption. When innovation is visible by users, it is more likely adopted [31]. Perceived complexity has been extensively studied by IT researchers. Several studies find significant relationships between perceived complexity and use intentions ([33]; [39]; [40]). Perceived relative advantage is 'the degree to which an innovation is perceived as being better than the idea it supersedes' [35], which include several dimensions to perceived relative advantage, increasing economic profitability, low initial cost, decreases in discomfort, and social prestige. Perceived relative advantage has received empirical support as having significant influence on use intentions ([32]; [33]; [38]; [39]).

The findings of Wu and Want (2005) indicated that all ID factors significantly affected users behavioral intent of mobile commerce [41]. Among them, the compatibility had the most significant influence. Diffusion theory is rooted in studies of mass media communications, and can be germane to field such as information systems and management [18]. From the above discussion about IDT factors, we assume hypotheses 3 to 7.

H_3: Perceived compatibility of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.
H_4: Perceived trialibility of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.
H_5: Perceived observability of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.
H_6: Perceived complexity of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.
H_7: Perceived relative advantage of the NFC mobile payment system has a positive effect on consumer's attitude of adoption for the NFC mobile payment system.

Effects of Consumer Adoption Attitude on Use Intention

In general, people perform behavior that is in accordance with their attitudes [14]. The TAM is a multiattribute model that predicts consumers' intentions to use a technology based on their perceptions of the user adoption attitude of the system [10]. Positive effects of attitude toward using an innovation technology on behavioral intention are proposed in the TAM [10], TRA (theory of reasoned action [14]), and TPB (theory of planned behavior [1]). Positive effects of attitude toward a behavior on behavioral intention are empirically shown in several studies ([1]; [10]; [14]; [28]; [29]). Therefore, hypothesis 8 can be formulated.

H_8: Perceived adoption attitude of NFC mobile payment system has a positive effect on consumer's use intention for the NFC mobile payment system.

RESEARCH METHODOLOGY

This study surveys consumer attitudes toward NFC mobile payment system chosen from Taiwan market. In addition, the questionnaire items are designed and then modified to make them appropriate for assessing attitudes toward NFC mobile payment system. Young consumers were chosen as survey targets. The data are collected over a period of two months (January to February, 2009). The research findings and suggestions are provided to examine the relationships among TAM, IDT and consumer adoption attitude and use intention for NFC mobile payment system. Data analysis methods used in this research include factor analysis, reliability analysis, and a linear regression method.

STUDY FINDINGS

This section discusses the data source and analysis results of the survey. Specific sites of Taipei County were chosen as survey sites. The population for this study mainly comprised young consumers. Over 240 questionnaires were issued, resulting in 220 responses. Of those received, 20 were removed because the responses were not valid. Thus, 200 responses were included in the final analysis. Based on the returned questionnaires, 42 percent of respondents are male, 58 percent of respondents are female. About 79 percent of the respondents are between 20 and 25 years old.

Factor Analysis and Reliability Analysis

To verify the relationships among the factors, the study performs factor analysis and reliability analysis using SPSS statistical package [27]. This entails a two stage process. Factor analysis is undertaken to identify underlying constructs from among sets of many

interrelated items. The principal - component method is used for factor extraction, with factor interpretation carried out by Variamax rotation.

Table 1 shows the factor analysis and reliability analysis for technology acceptance model. Two factors including perceived usefulness and perceived ease of use are produced using factor analysis. All factor loadings of variables exceed 0.8, while the α values of the item to total correlation exceed 0.8. Table 2 shows the factor analysis and reliability analysis for ID theory. Factors including compatibility, trialability, observability, complexity, and relative advantage are produced using factor analysis. With the exception of compatibility, trialability and observability, which have lower α values for the item to total correlation, all other factor loadings of variables exceed 0.7, while the α values for the item to total correlation exceed 0.6. Table 3 shows the factor analysis and reliability analysis for consumer adoption attitude and use intention. With the exception of use intention, which have lower factor loadings and lower α values for the item to total correlation, all factor loadings of variables exceed 0.7, while the α values for the item to total correlation exceed 0.7. The nine factors appear to be appropriate for next linear regression analysis.

Table 1. Factor and reliability analysis of technology acceptance model factors

	Factor Analysis		Reliability Analysis
	Eigenvalues	Factor loadings	α
Perceived usefulness			
Using the NFC mobile payment system can reduce the inconveniences of cash or credit card requirements of consumption.	2.19	0.87	0.81
Using the NFC mobile payment system allows rapid conduction of overall trade actions.		0.88	
It does not require a lot of time to learn how to use the NFC mobile payment system.		0.82	
Perceived ease of use			
I find the NFC mobile payment system is easy to use.	1.69	0.92	0.81
I consider the interaction design of the NFC mobile payment system is easy for me to understand.		0.92	

Table 2. Factor and reliability analysis of innovation diffusion theory factors

	Factor Analysis		Reliability Analysis
	Eigenvalues	Factor loadings	α
Compatibility			
Using the NFC mobile payment system fits well with my prior payment experiences.	1.66	0.71	0.59
Using NFC mobile payment system is a good complement to traditional methods.		0.77	
Use of the NFC mobile payment system still offers the original payment methods.		0.75	
Trialability			
Before deciding whether to use the NFC mobile payment system, I want to try its functions.	1.41	0.84	0.58
I want to spend time trying the NFC mobile payment system, in order to understand its functions.		0.84	
Observability			
I can talk about the NFC mobile payment system with my friends.	1.59	0.67	0.55
Benefits of the NFC mobile payment system are easy to understand.		0.74	
Under my circumstances, the services of the NFC mobile payment system are commonly used.		0.77	
Complexity			
The difficulty and complexity of use of the NFC mobile payment system is important to me.	1.83	0.72	0.68
Easy operating features of the NFC mobile payment system will attract me to use it.		0.80	
Using the NFC mobile payment system is very simple, which is an important consideration factor for me.		0.82	
Relative Advantage			
If the NFC mobile payment system can provide more complete and convenience services, as compared to current payment mechanisms, I will use it.	1.52	0.87	0.68
If the NFC mobile payment system can provide more value-added services, I will use it.		0.87	

Table 3. Factor and reliability Analysis of consumer adoption attitude and use intention

	Factor Analysis		Reliability Analysis
	Eigenvalues	Factor loadings	α
Adoption Attitude			
Using the NFC mobile payment system seems a very nice idea.	2.11	0.77	0.78
It seems a smart decision to use the NFC mobile payment system.		0.88	
The NFC mobile payment system seems valuable to use.		0.86	
Use Intention			
I will ask questions of consumer that have used the NFC mobile payment system.	1.46	0.55	0.43
I will recommend my friends use NFC mobile payment system.		0.87	
Using the NFC mobile payment system is very expensive; however, I am not concerned.		0.67	

One of the assumptions of regression analysis is that the residuals for consecutive observations are uncorrelated. If this is true, the expected value of the Durbin-Watson statistic is 2. Table 4 and Table 5 show that the values of the Durbin-Watson of the models are all near 2, which fit the requirement of the assumptions of regression analysis.

In Table 4, the results of regression model 1 and model 2 suggest that the perceived usefulness, perceived ease of use of consumer perception have positive effects on the consumers' adoption attitude concerning NFC mobile payment system. In regression models 3 to 7, significant results are obtained on the importance of ID theory: compatibility, trialability, observability, complexity, and relative advantages are important to consumer adoption attitudes concerning the NFC mobile payment system. Meanwhile, high usefulness, ease of use of NFC mobile payment system, and appropriate innovation diffusion methods: increasing compatibility, reducing complexity, high trial availability, ability to observe, marketing environment, and high relative advantages of new technology are helpful to the consumer's attitude concerning adoption of the NFC mobile payment system.

Table 5 compares the applications of TAM and IDT on consumer adoption attitudes. Model 8 shows that both perceived usefulness and perceived ease of use appear as significantly important to consumer's attitude of adoption of the NFC mobile payment system. Regarding the ID theory, among five factors, only relative advantages, and observability appear to significantly effect consumer's adoption attitudes. Both theory factors were considered in the regression, as shown in model 10, only perceived usefulness of the TAM and the observability of the ID theory appear to significantly effect consumer's adoption attitudes. Model 11 is the final model, which shows that if service firms and related IT firms could increase perceived usefulness and ability to observe the NFC mobile payment system, then the adoption attitude of consumers will be enhanced. Finally, model 12 indicates that adoption attitude appears to have significant effects on consumer's intention of use, therefore, if firms could apply the TAM and ID theories to increase consumer adoption attitudes, then the use intention of consumers could be effectively increased. In Taiwan, due to the familiarity of Easycard transit services, some respondents indicate that if Easycard transit services could be integrated into their mobile phone, convenience would be greatly increased. In this study, most young consumers, who are familiar with new technologies and expect new products, primarily consider the usefulness and ability to observe new technology products to be important when making purchase decisions. Therefore, perceived usefulness of the technology acceptance model and observability of the ID theory are most important factors of

market development strategies of the NFC mobile payment system for Taiwan young consumer.

Table 4. The determinate effects of TAM and IDT factors on consumer adoption attitude

		Adoption Attitude						
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
		Beta	Beta	Beta	Beta	Beta	Beta	Beta
TAM	Perceived usefulness	0.46***						
	Perceived ease of use		0.33***					
IDT	Compatibility			0.26***				
	Trialability				0.30***			
	Observability					0.35***		
	Complexity						0.36***	
	Relative Advantage							0.34***
Constant		1.76***	2.31***	2.56***	2.34***	2.35***	2.17***	2.21***
R		0.52	0.39	0.30	0.43	0.36	0.42	0.37
Adjusted R^2		0.26	0.15	0.08	0.18	0.13	0.17	0.13
Drubin-Waston		1.95	1.77	1.65	1.96	1.69	1.83	1.86
F		72.43***	35.92***	19.22***	45.83***	29.66***	42.92***	31.47***

a Dependent Variable: Adoption Attitude
b Beta: Unstandardized coefficients
c *p<0.05, **p<0.01, ***p<0.001.

Table 5. The comparable effects of TAM and IDT factors on consumer adoption attitude

		Adoption Attitude				Use Intention
		Model 8	Model 9	Model 10	Model 11	Model 12
		Beta	Beta	Beta	Beta	Beta
TAM	Perceived usefulness	0.39***		0.24***	0.40***	
	Perceived ease of use	0.14*		0.09		
IDT	Compatibility		0.05	-0.02		
	Trialability		0.13*	0.11		
	Observability		0.21***	0.13*	0.19**	
	Complexity		0.11	0.81		
	Relative Advantage		0.16**	0.10		
Adoption Attitude						0.41***
Constant		1.59***	1.22***	0.91***	1.40***	1.71***
R		0.53	0.54	0.61	0.55	0.43
Adjusted R^2		0.26	0.29	0.35	0.30	0.18
Drubin-Waston		1.94	1.79	1.94	1.88	2.02
F		39.46***	16.48***	22.35***	43.05***	45.85***

a Dependent Variables: Adoption Attitude, Use Intention
b Beta: Unstandardized coefficients
c *p<0.05, **p<0.01, ***p<0.001.

DISCUSSION AND CONCLUSION

This study explores Near Field Communication system application in the Taiwan service industry. Consumers are surveyed and statistical methods used to verify key factors of a firm's innovation technology promotion strategy. The contribution of this research is to

incorporate TAM and ID theory key factors, as well as consumers' adoption attitude and use intention in order to construct a meta-dialogue for their relationships. Findings of the research provide support for the theoretical base that some TAM factors (e.g. [3]; [4]; [26]; [30]; [31]), and ID theory factors (e.g. [13]; [31]; [32]; [39]) do have a significant impact on consumers' adoption attitude and then lead to use intention concerning Near Field Communication system application.

Regarding the TAM model, the research findings indicate that increasing the perceived usefulness and perceived ease of use of the NFC mobile payment system will lead to higher degrees of consumer adoption attitudes. Therefore, if service firms could promote mobile payment systems, in terms of emphasizing the superior functions of NFC, such as real-time service, job utilities, and convenience, then the adoption attitudes of consumers will be effectively encouraged. Furthermore, the ease of use of the NFC system could decrease consumer psychological barriers and increase the intentions of consumer to use the NFC mobile payment system.

The analysis results of the ID theory show that perceived compatibility, trial availability, complexity, observability, and relative advantages of the NFC mobile payment system could effectively increase the adoption attitudes of consumers. In Taiwan, mobile payment service has not been broadly adopted by consumers. Therefore, the trial availability and ability to observe activities are required to plan and promote consumer trials to familiarize consumers with the new technology applications. Furthermore, low complexity is also important to consumers, while considering adopting the NFC mobile payment system. Compatibility of the NFC mobile payment system with original mobile phone systems are also important considerations for consumers. Finally, the infrastructure behind the NFC applications in service industry is complex and requires the cooperation on different levels to ensure interoperability and a thriving contactless scheme to be deployed [23]. The findings of this study suggest that consumer adoption attitudes will be increased if service firms could increase the relative advantages of the NFC mobile payment system, for example, through cooperation with omni bearing services, in terms of strategic business alliances, to provide more value-added mobile services, then, the attractiveness of the NFC mobile payment system will be increased in the consumer's mind.

NFC mobile payment systems are well developed throughout Europe and Japan, however, in Taiwan, the NFC system still has not been broadly adopted by consumers. Management implications and promotional strategies are suggested as follows: 1) Develop business operation models: Allow related firms to comprehend the advantages of the NFC mobile payment system, import, and integrate business operations and cooperative models to increase firms' participation intentions. When the perceived usefulness and relative

advantages and the NFC system, as compared to other general mobile or payment methods, appear, then the adoption attitudes of consumers will be enhanced. 2) Enlarging the service demands of consumers: mobile universal rates in Taiwan require strategies to increase consumer adoption attitudes, includes increasing compatibility (reducing adapted barriers) and decrease complexity (ease of use) of the NFC mobile payment systems. Design trial availability, and ability to observe marketing environments for consumers to experience the NFC system to enhance service demands. 3) Customization marketing: Designing various marketing activities from various channels or agencies, for example, acceptance degrees of young consumers concerning new technology applications are apparently higher than with the elderly consumers. Therefore, emphasizing the unique attributes and functions to young consumers is important, and emphasizing low complexity and relative advantages will interest elderly consumers.

The limitation of this research is that it is based on only 200 respondents. However, respondents who are involved in the adoption decision of NFC mobile payment system. Future research could extend the scope of samples, and add other discussion factors, such as age, risk attitudes, and various user types to expand the conceptual framework. A broader approach (e.g. multidimensional scale, structure equation model, etc.) would be valuable in analyzing the causal relationships among the factors.

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INNOVATION INFLUENCE ON STRATEGIES OF ROMANIAN SERVICE FIRMS

Professor Cezar SCARLAT, PhD
cezarscarlat@yahoo.com
Lecturer Catalin ALEXE, PhD candidate
cataalexe@yahoo.com
University "Politehnica" of Bucharest, Romania

ABSTRACT

As the innovative potential of companies is increasingly becoming an engine of development, the literature deals with lots of related subjects – as innovation culture, innovation efficiency and investment in innovation, innovative technologies, innovation and strategy – to mention just a few of them.
In spite of its innovative potential, only 6.8% of Romanian entrepreneurs think that their firm brings on the market new or improved products and services; and the percentage of the innovators is lower than the one reported in the more developed countries.
Trying to identify the reasons, the paper presents some of the results of questionnaire-based research work, completed in 2005-2006, aiming at identifying links and correlations between innovation and innovative elements – on one hand – and the company strategy and decisions of the top management – on the other. Managers of 255 Romanian companies were subject of this survey – a significant number of them active in service industries as: consumer services; banking, investment, insurance; engineering, research and development; management consulting and business services; retail or wholesale trade; transportation and public utilities.
Conclusions are important for all business strategists and top managers of service companies.

Keywords: innovation, innovative technology, incremental vs. radical/disruptive innovation, innovation strategy, business strategy, service industry

INTRODUCTION: INNOVATION AND ORGANIZATION

Service firms can gain significant advantage by fostering innovation. Innovation is a powerful competitive advantage that is available to any firm that seeks and develops the necessary skills. Innovation depends more on the intention to innovate than it does upon corporate size and wealth.

In the global economy, to be innovative means to do something different and better than others (Ettile, 2006). To be innovative doesn't mean only to think creatively, but to turn creative ideas into something valuable for the organization and its customers, to bring extra-value. The success of the firms is intimately linked to the innovation (Peters, 1997).

Innovation is an active process. The companies which are not actively and continuously innovating are sentenced to failure, actually. The critical component of innovation focus is that it generates the learning capacity: "It is not so much the ability to operate at the global frontier which is important, but the capacity to continue to operate at a continuously expanding global frontier which counts" (Kaplinski, 2007: 82).

Innovation is beneficial to the firm if it leads to increased competitiveness. As Harrison reported (2002), the 1996 Global Manufacturing Futures Survey conducted in over ten countries and/or regions examined the correlation between investment in innovation activities and manufacturing performance improvements. It was observed that "those companies that are serious in implementing innovation management can identify significant operational improvements in performance" (Harrison, 2002).

Within organizations, it is not enough as one or more employees of an organization to be creative and have the intention to innovate so that we can talk about *innovative organization.* Organization creativity represents some average of the people's creativity within organization. Even if the creative potential of individuals is important, it does not mean that the organization's potential of innovation is high. The explanation: the people's creative potential in a firm can be ignored, underused or misused (Alexe, 2008).

It is not enough that managers deal with the rise in personnel creativity. In order to be innovative, entire organization as a whole has to offer an adequate framework for development and valorization. The rate of innovation in an organization depends on the management capability to create this context of updating the creativity throughout the organization. Therefore, good ideas are left disconnected and, often, they are lost. The solution is setting up an *innovation culture* (Scarlat, Alexe, 2008). Innovation culture and entrepreneurship are intimately correlated (Scarlat, Alexe, Simion, 2008).

The Innovation DNA Model[1] presents the innovation culture as one of the eight dimensions that are the basis of innovation within an organization:

1. Change, ideas, passion and trends. These are the innovation drivers. They provide the stimuli needed to start the innovation.
2. Challenge. The bigger the challenge and the passion behind it, the more energy the innovation efforts will have.
3. Customer focus. Innovation finally leads to create value for the customer. Interacting with and understanding the customers' needs are one of the best stimulators of new possibilities of innovation.
4. Creativity. The start point in innovation is the creativity and it follows up providing of potential useful ideas. Innovations means to bring successfully on the market a creative idea among many other possibilities.
5. Communication. Open communication of ideas, information and feelings is the lifeblood of innovation.
6. Collaboration. Innovation is a group process. It feeds on interaction, information and a shared vision.
7. Continuous learning. Learning from completed projects is favorable for the innovative projects that will come up.
8. *Innovation culture.* Creating an environment that honors ideas, supports ideas generation and communication, tolerates risk and may be the biggest challenge facing all organizations that want to be innovative.

Innovation is supported, more or less, by several types of organizational cultures – but an innovative culture is not achieved easily and requires strategic thinking (Angel, 2006). There is no guarantee that a breakthrough organizational culture will lead to innovation, but it certainly is a prerequisite.

The recent experience in Sub-Saharan Africa demonstrates that (excluding South Africa) the only significant manufactured export has been clothing while opportunities in service industries are neglected. Therefore, "the focus for development strategies targeting sustainable incomes needs to shift from industrialisation to innovation, and within that, to the endogenisation of learning capabilities in an appropriate comprehensive innovation strategy" (Kaplinsky, 2007).

The organization innovativeness is influenced by factors as external environment and organisational structure, and the firm's dynamic capabilities, which are relevant to managerial and organisation processes (Spanos and Prastacos, 2004). Based on survey data drawn from a sample of leading Greek firms, they have shown that the firm's dynamic capabilities, even though environmental and structural variables, seem to exert a significant influence on product innovation strategy.

Traditional organizations embrace their past, as a rule, they stick to a winning formula and seek for more efficient ways of achieving objectives and minimizing risks. Many times, we meet in these firms a culture of low risk, which leads to *incremental innovation*. Most of the innovative activity at the industrial enterprise level is incremental innovation. It focuses more on products and less on processes. Incremental innovation brings small changes every time; through accumulation, in time, it can lead to bigger changes, as it is received favorably by old producers on the market, because of lower investments and risks.

Radical innovation brings substantial changes associated to larger investments and risks, and offers opportunities to some new producers to enter the market. Once a radical innovation is brought in on the market, many and various incremental innovations spring around.

Based on a Norwegian case study, Hagen (2008) describes the new concept of environmental innovation and the way it is presented in the firm's strategic and identity documents. It could be either incremental or radical. The study suggests that the incremental innovation is stimulated by integration of industrial ecology into the corporate saga – while the radical environmental innovation is, however, hindered by such integration: radical innovation means discontinuity and confrontation with the dominating history of the company (Hagen, 2008).

The way from the incremental innovation to the radical one goes through broader and broader innovative activities which imply higher risks, but an increased degree of creativity. Incremental innovation assumes a series of processes which are more or less creative (even the attempts to copy the novelties occurred on the market due to the competition, imply time and again intense efforts of creative adjustment).

McFadzean's paradigm: Although innovation management is much more complex in case of radical innovation, the incremental innovation requires a larger volume of knowledge about the innovation management (McLaughlin, Bessant, Smart, 2000).

There are significant differences between organizations oriented towards incremental or radical innovation as far as organizational structure, procedures, human resources, methods of work, management systems and final results (Table 1).

Table 1. Differences between incremental and radical innovation

Incremental innovation		*Radical innovation*
▪ Formalized ▪ Centralized ▪ Systematic	*Procedures*	▪ Un-formalized ▪ Decentralized ▪ Loosely structured
▪ Functional ▪ Efficiency oriented	*Organizational structure*	▪ Facilitating knowledge gathering ▪ Supporting risk taking
▪ Homogeneous ▪ Older and experienced	*People*	▪ Heterogeneous ▪ Younger and entrepreneurial ▪ Ambitious ▪ Technical ▪ Questioning
▪ Mature ▪ High inertia ▪ Focus on efficiency ▪ Focus on team-working ▪ Continuous improvement ▪ Low investments ▪ Minor risk taking	*Characteristics of the organization*	▪ Entrepreneurial ▪ Emphasis on intrapreneurship ▪ Focus on discovery ▪ Individual co-operation ▪ High investments ▪ Major risk taking
▪ Cost reduction ▪ Feature addition ▪ Efficiency improvement	*Focus*	▪ Experimentation ▪ Creativity ▪ Foresights ▪ Psychology ▪ New methods and technologies ▪ New products
▪ Mostly existing	*Products/Technologies*	▪ Mostly new
▪ Linear ▪ Predictable	*Processes*	▪ Non-linear ▪ Explorative ▪ Experimental
▪ Between 6 - 24 months	*Periods for notable and practical achievements*	▪ Between 2 and 7 years
▪ Develop systems to make knowledge accessible across the organization	*Knowledge management*	▪ Knowledge is created and managed within the team
▪ Collaboration over various projects ▪ Long-term agreements	*Partnerships*	▪ Partners provide access to capabilities that the organization lacks
▪ Monitor current competitors and current eco-system	*External monitoring*	▪ Monitoring idea generation places-universities, labs, startups
▪ Exploitation	*Management*	▪ Exploration

Source: After McLaughlin, Bessant & Smart; Davila, Epstein & Shelton (2007)

Mature firms are less interested in radical innovation, as the mechanisms that allow them to be successful become inhibitors to innovation. Major risks involved by the radical innovations are more difficult to be accepted by larger firms.
Entrepreneurs with new and daring ideas are those who made breakthrough innovations within the framework of some small firms; their wish to put into practice their own ideas is much stronger than the assumed risks; economic and financial calculations are overtaken by their dreams.

Christensen (2003) has analyzed the innovative technologies, as *sustaining and disruptive technologies*. While the impact of sustaining technology is to improve the product's performances incrementally, disruptive technology represents discontinuous jump forward in product's performance. Based on the RPV framework[2], Christensen developed the model of strategic decisions in case of innovative technologies: *The strategic decisions are affected by these factors; success or failure of implementing the disruptive technologies do not depend on resources but processes and values.* When the capabilities (processes and values) required by the innovative technology do match with the current organization's capabilities, it is a matter of resources only – for a successful technology implementation.

The new technologies lead to process renewal. The "old and proven way of doing business" requires changes in the operational mode. However, in today's turbulent business environment, new technologies, continuous innovation and changes may cause chaos in the prevailing circumstances (Suikki, 2007). As the process renewal driven by disruptive technologies differs from management-driven process renewal, appropriate methods and deep understanding of the process should be used in each case. Suikki (2007) describes how the process renewal driven by disruptive technologies in the Nokia case unit was successfully managed, in the turbulent telecommunications business environment. The challenge was solved using a combination of adapted processes, focusing on the customer, and competence development.

Innovative technologies substantially diminish the personal interaction in service provision. Walker and Johnson (2004) discuss the implications of the diffusion of the technology-enabled service innovations.

INNOVATION AS NATIONAL STRATEGY

In many countries, innovation is part of the government policy. Just a few examples will follow.

- Since 1997, the Labour government in the UK has promoted policies of competitiveness and innovation, assuming the role of "enabler of a knowledge driven economy" – in order to stimulate competitiveness and define a third way between market-led economic policies and state intervention (Druker, 2003). However, the evidence "suggests that the rhetoric concerning the government's role as an enabler of innovation is stronger than the reality".

- Nigerian government is focused on information technology education and the National Information Technology Development Agency is a national initiative designed to dramatically improve the country's competitiveness in computer industries. Ariguzo et al. (2007) have investigated the effectiveness of public-private partnerships in IT and communication industries in Nigeria and provided recommendations for Nigerian Higher

Education Institutions and IT businesses in order to develop effective IT&C public-private partnerships.

- The Korean government has taken policy initiatives for the long-term planning of national innovation (as the promotion of basic research, the increase of national R&D investment, strengthening human resource development). Other important issues promoted: start-up of technological innovation ventures, international patents, scientific publications, and the private research institutes. According to the research conducted by Lee and Kwun (2003), the Korean government policies are characterised as government-initiated, target-oriented or plan-based, and input-focused – "which has caused its inability to tackle existing problematic practices ... as under-utilisation of research resources in universities, ... and created such unexpected problems as ... loss of entrepreneurship among venture businesses ..." Overall, the Korean public innovation policies "are undergoing the test of reshaping in their progress to a knowledge-based economy" (Lee and Kwun, 2003).

- Taiwan was very successful in using tax incentives, science-based industrial parks and public research institutions to promote and encourage R&D and innovation. The government has largely used new instruments (venture capital, innovation incubators, an open laboratory system, and e-commerce) but "the effectiveness of these policies cannot be assessed at this moment because they are too new" (Lee and Wang, 2003).

- In Thailand, Virasa (2007) has developed an analytical model to analyse the gap in government support for New Technology-Based Firms (NTBFs), which integrates the characteristics of NTBFs and various dimensions on entrepreneurial process and technology commercialisation. Benefits of this modelling process and a series of suggestions for public interventions on fostering entrepreneurship and innovation are presented.

The radically changing business environment opens new opportunities and forces the organizations to reshape their strategies. In their study on the service industries in Finland (electricity distribution, telecommunication industry in the beginning of the 1990s), Bergman et al. (2008) provide guidelines for future-oriented innovation management - for companies as well as for public authorities.

As cited by Kaplinsky (2007: 80-81), Lall and Teubal (1998) have provided a theoretical architecture and a three-level framework for developing innovation policies:

i. *Functional policies* – designed to improve market operations (as competition policy; trade tariffs).
ii. *Horizontal policies* – which cross sectors (as incentives to promote R&D training).
iii. *Selective policies* – designed to promote the advance of particular sectors (as preferential access to capital; sector-specific subsidies), particular regions or particular firms.

According to the same author (Kaplinsky, 2007), Broadman (2007) proposes an export-oriented innovation policy framework in Sub-Saharan Africa as comprising of a mix of Behind the Border (predominantly infrastructure), Beyond the Border (predominantly market access) and Between the Border (predominantly logistics) issues.

In 90s, the centralized totalitarian regimes have collapsed in Eastern Europe. The transitional changes have changed the economic and social landscape in the region. Kutlaca (2008) explores the main consequences of these transitional changes in the R&D sector in Serbia, which are partly oriented towards the creation of an innovation infrastructure.
The qualitative analysis of the effectiveness of the innovation infrastructure leads to the conclusion that public awareness and acceptance of innovation infrastructures are rising; political and financial support are larger and larger; the number of innovators is rapidly increasing; and the R&D sector has been integrated into the Science and Technology and Innovation system (Kutlaca, 2008).

In Romania, the National Strategy for Research, Development and Innovation (2009-2013) is currently in force – as result of a large consultation process, including the first national foresight exercise (2005-2007) led by the National Council of Scientific Research in Higher Education.

INNOVATION AND STRATEGY IN ROMANIAN SERVICE INDUSTRIES

In spite of its innovative potential, Romania does not document the same optimistic view on the business side: According to EUROSTAT Report (2006), only 6.8% of Romanian entrepreneurs think that their firm brings on the market new or improved products and services. The rest of the interviewees were satisfied to imitate the competition.

The percentage of the innovators is lower than the one reported in the developed countries – such as Luxemburg (25.8%) or Sweden (39.9%) – and neighboring emergent economies or ex-communist countries as Bulgaria (9.6%) and Czech Republic (19.6%).

Trying to identify the reasons, both secondary and primary researches were conducted. Secondary research completed in 2005-2006, among the professional associations led to the list of potential interviewees, Romanian companies with more that 5 years of activity. Managers of Romanian service companies were subject of this survey – companies active in service industries as follows:

- Consumer services (36.5%)
- Retail or wholesale trade (25.8%)
- Engineering, research and development (13.8%)
- Management consulting and business services (7.5%)
- Transportation and public utilities (5.7%)
- Banking, investment, insurance (4.4%).

Simultaneously, as result of several focus group analyses, a questionnaire was developed, aiming at identifying links and correlations between innovation and innovative elements – on one hand – and the company strategy and decisions of the top management – on the other. The innovation rate was defined as “the percent of the company’s revenue generated by products that did not exist three years earlier”. There were considered four “grand strategies”: stability, internal growth, external growth (by acquisitions), and retrenchment strategy.
The questionnaire was addressed to top-managers. 255 valid questionnaires were analyzed.

The data processing has revealed the following results:

- Almost one third are companies that reported innovation rate under 20% (17.2% companies under 10% innovation rate and 13.0% companies with innovation rate between 10%-19%).
- Almost half of the companies (47.1%) reported innovation rate between 20% and 50%.
- More than one fifth of the surveyed companies reported high and very high innovation rates: between 50-70% (11.8%) and over 70% (10.9%) respectively.
- Most of the companies declared stability (43.9%) and internal growth (33.5%) as their predominant strategy; 15.1% were in difficult situation as their strategy was retrenchment; only 7.5% of the companies have grown by acquisitions.
- Correlation analysis has suggested no strong correlation between innovation and grand strategy. However, two significant aspects should be mentioned:
  - All companies that grew up based on acquisitions have innovation rate superior to 10%; half of them reported innovation rates between 30%-50%;
  - Two thirds of the companies applying retrenchment strategies have innovation rates under 30%.

Other comments on the qualitative aspects:

- Lacking the financial resources to purchase licenses, patents and know-how, the modernization of the processes and products is achieved through imitations that have a bigger or smaller success depending on the organization's capacity of change, abilities, knowledge, and *personnel's creativity.*
- In the absence of their own innovation activities, many Romanian firms do have an imitation behavior: to transfer the successful innovations from the developed economies into Romanian economic context; consequently, the technology gap has deepened.
- For most imitators, the effort to imitate is significant; more significant when the firm is rather new, inexperienced, and less prepared technologically.
- There were cases of successful imitators who creatively adjusted the products and services, which has led to incremental innovation; imitators have had increased chances to succeed as they improved the original innovation model, becoming innovators themselves.

Conclusions are important for all business strategists and top managers of service companies.

CONCLUSIONS

In order to be competitive, firms have to innovate. The innovation culture is the ideal environment. As part of the innovation process, according to the intensity of the firm's strategic and structural change, incremental or radical innovation is possible. Incremental and radical innovations are associated with incremental and disruptive technologies, respectively. Incremental changes have the role of spreading base technology within the firm, while the radical innovations represent breakthroughs so important that they have to be sustained by an essential change of the organizational culture and firm's structure. As the incremental innovations may not involve major changes in the enterprise's strategy, they do not always cause the change of the enterprise's organizational culture and structure.

The growth of the Romanian service firms is based on incremental technological progress rather than radical, disruptive technologies.

In Romania, among the service companies, there is no strong correlation between innovation and grand strategies. However, it seems that less innovative firms are mostly firms in difficulty as two thirds of the companies applying retrenchment strategies have innovation rates under 30%.

The research suggested that innovation has a role in external growth of service companies: all companies that grew up based on acquisitions have innovation rate superior to 10%.
Half of the firms that aggressively grew up by acquisitions report relatively high innovation rates (30%-50%).

In the absence of their own innovation activities, many Romanian firms do have an imitation behavior: to transfer the successful innovations from the developed economies into Romanian economic context. Consequently, the successful imitators become innovators themselves but the technology gap is deepening, overall.

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NOTES

[1] DNA = Denver Network Association.

Authors of the Innovation DNA Model are members of the Innovation Denver Network Association (Innovation DNA: Framework of Principles. Available at: www.thinksmart.com/mission/dna)

[2] RPV = Resources (people; relations with customers, suppliers, distributors; equipment; technology; product designs; brands; information; money), Processes (patterns of interaction, coordination, communication, and decision-making through which resources are transformed into products and services of greater value), Values (standards by which employees set priorities and make decisions).

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REQUIREMENTS FOR SOFTWARE REUSE: AN INTELLECTUAL CAPITAL VIEW

Tauno Kekäle, University of Vaasa, Vaasa, Finland
tke@uwasa.fi
Carmen Cabello Medina, Pablo de Olavide University, Seville, Spain

ABSTRACT

In this paper, we propose an intellectual capital view for understanding how successful software reuse really takes place in the software development companies. We present two different cases on how the reuse of the code is arranged, based on different management philosophies that again have their basis on different corporate situations: software reuse based on "ad-hoc" specialists and software reuse based on libraries and repositories. Our "ad hoc" case spreads human capital to organizational use through social capital, while our other case uses organizational-capital systems to spread the human capital and knowledge for software reuse. We suggest that these two systems would be in play in different types of companies; the ad-hoc social capital reuse system in small, young, or with simple products; organizational capital reuse systems more typically with more established, bigger, distributed, or with complex products. However, practical implementations seem to depend very much on the actual situation that can be a combination of the cases we suggest here, which could require combining human capital with either social or organizational capital or even with both; so, even code reuse, which would seem to be a very structurable activity, is clearly contingent.

INTRODUCTION

The success of software development companies depends on their ability to generate, assimilate, reuse and leverage their knowledge (Desouza, Awazu and Tiwana, 2006). This ability to leverage valuable existing knowledge internally is critical to building competitive advantage because of both the scarcity of valuable internal knowledge and the difficulty and expense of creating new knowledge (Szulanski, 1996). Software reuse is a software *process* innovation in that it shifts the focus from developing software artifacts for a single product to developing them for a future family of applications (Sherif and Menon, 2004). Developers reuse and recombine knowledge early in their involvement with the project, and then continue to work and contribute novel software code while refining the software product (Von Krogh, Hafliger and Spaeth, 2006). Software reuse already exists within most organizations, and is promoted by systems standards such as CMM and its derivatives. Nevertheless it's rarely discussed because it usually starts and ends in an informal way, with management having little understanding of how it started, why it persists and how they might proactively extract larger benefit from it (Lior and Jan, 2005).

Thus, we propose an intellectual capital view for understanding how successful software reuse really takes place in the software development companies. Three subcategories of intellectual capital may be considered (Subramaniam & Youndt, 2005): human capital, organizational capital and social capital. Given that the three parts of intellectual capital are interdependent, we want to analyze how they could interact for improving the innovation results of software reuse.

In this paper we present two different cases on how the reuse of the code is arranged, based on different management philosophies that again have their basis on different corporate situations: software reuse based on "ad-hoc" specialists and software reuse based on libraries and repositories. Although some people hold that knowledge repositories play a relatively unimportant role in knowledge reuse, arguing that face to face communication and good knowledge sharing processes are the keys to successful knowledge reuse, others are much more persistent about the potential for formal repositories especially in big software projects (Markus, 2001).

We thus propose that each of these different processes of knowledge reuse uses, as the main source of knowledge, different combinations of the elements of Intellectual Capital. The conclusion we make is that human capital processes are the key factor for software reuse, and investment in human capital is a good way to improve the code reuse processes. However, practical implementations seem to depend very much on the actual situation, which could require combining human capital with either social or organizational capital; so, even code reuse, which would seem to be a very structurable activity, is contingent.

Intellectual capital processes

With few exceptions, productivity in modern firms is based on the intellectual competence and system capabilities of the firm rather than on *hard assets* (Quinn, Anderson & Finkelstein, 2005; Boekestein, 2006). Managing the intellectual capital is a challenge especially for companies such as the software development companies, whose main resource base is their knowledge resource (Schoemaker and Jonker, 2005). Research focused on the analysis of this kind of companies provides interesting arguments clearly connected with the statements of the intellectual capital framework, even if the correlation between intellectual capital (as reported in intangible assets on the balance sheets) and company performance are not always visible (Boekestein 2006; however, Wang and Chang, 2005 and Lee, Lee and Lin, 2007, claim the opposite in their ICT and e-business studies). In theory, intellectual capital should be of greatest importance in innovative and knowledge-based fields (Cunningham, 2002; McElroy, 2002; McElroy, Jorna and van Engelen, 2006).

Three subcategories of intellectual capital may be considered (Subramaniam & Youndt, 2005): human capital, organizational capital and social capital. Sawyer and Guinan (1999) correspondingly highlight three perspectives in software development processes: the individual, the production, and the social perspective. In this paper, we illustrate with the connections of these subcategories of intellectual capital to software reuse within the software development process; we claim this may be the stage where human capital produces especially good return-on-investment.

Human capital, as a part of the intellectual capital, concerns the individual level and refers to knowledge and capabilities of employees who belong to the firm. Through selection and training processes managers may develop correct type of human capital to achieve the organizational aims. In many ways, human capital is comparable to the *individual perspective* of software development, which focuses on the unique contributions of individuals to the development team. Following Sawyer and Guinan (1999), issues from an individual perspective can include, for example, the degree of experience and skill that each software developer contributes.

For improvements in the human capital, or the human perspective of the development process, companies should design the selection and training processes that assure the level of

knowledge and capabilities of individuals that are needed for the company to run its main tasks. The sum of the employees' knowledge doesn't, however, guarantee that the knowledge of the firm (intellectual capital; Nahapiet & Ghoshal 1998) is a real competitive advantage (Bueno, Salvador and Rodriguez, 2004; Schoemaker and Jonker, 2005). Because of this, two other levels of knowledge must also be considered. Even when companies have exceptional individual talents, their contribution to their organization will not be significant unless their knowledge is networked, shared, and channelled through either institutionalized and formal mechanisms or interpersonal relationships (Subramaniam & Youndt, 2005). This would imply that companies that aim at reaching a competitive advantage through their knowledge resources should adequately manage the other two sides of intellectual capital, that is, organizational and social capital, which are also explored in this brief study.

Organizational capital corresponds to those aspects of explicit knowledge that may be documented and proceduralized. This can be particularly relevant for ICT companies as a way to preserve the knowledge generated within the firm. In these businesses, codification and documentation of the new software developed is essential if the companies do not want to risk that this knowledge only resides in the mind of the individuals involved, or if they want to make knowledge available for other individuals in the organization in a definite format. Organizational capital also implies the establishment of structured recurrent practices (Subramaniam and Youndt, 2005) and norms (McElroy, Jorna and van Engelen, 2006). This kind of knowledge is connected with the *production perspective*, which refers to how individuals should conduct the work, and it seeks to underscore the repetitive, predictable, and manufacturing-like aspects of software development. Reducing the variation in the development process, making the development process more routine, developing specific guidelines for how to best address common tasks, and making tools available to support these efforts, are seen as the central questions (Sawyer and Guinan, 1999). Organizational capital may become an important systematic source of knowledge for software reuse activity.

Social capital is the set of resources generated by interpersonal networks that are, therefore, embedded in and available within these networks (Nahapiet & Ghoshal, 1998). Collaboration and interaction among people are the bases for building social capital (Subramaniam & Youndt, 2005). For Sawyer and Guinan (1999), the *social perspective* focuses on how the software developers work *together* to produce software. This includes both informal communication and intra-group coordination activities such as discussing how activities will be performed, finding and taking the time to talk with other team members, resolving the conflicts that arise in the course of working together, and sharing of ideas and information (Sawyer and Guinan, 1999; Hoffman, Holscher and Sherif, 2005). Sometimes, software reuse may be based on social capital as an "ad-hoc" source of knowledge.

Software reuse: a specific form of organizational learning

There must be an organizational foundation in place for the software reuse to succeed, since many products are supposed to be built by the same building blocks made by domain-specific engineers ("product line approach"). The reuse process puts certain requirements on the code itself (e.g. robust open interfaces) but in order to build a system from existing assets, rather than building from scratch for each new application or customer, also some managerial requirements exist (Brownsword and Clements, 1996):

-definition of an organizational structure with the product line in mind, including core assets and the customer specific products with non-core functionality

-definition of the new product family members from the core assets with customer-specific requirements, and

-definition of a process for adding functionality to the core product line assets as required.

The idea of software reuse, thus, is based on knowing what pieces of functioning code that already exists, and then recognizing the need of one of these pieces and being able to find it easily; "collect, evaluate, and make available to software projects reusable software assets", "maintain the reusable assets by storing and providing an identification mechanism" and "incorporate reusable software assets into new or existing applications" (SEI 1996). The pieces of code that can be reused are, by the SEI definition, assets (=capital) of the organization. The most common reusable software entity types are processes, data and objects.

Depending on the level of abstraction of the software resources, the reuse process can be organized in different ways. For the most concrete resources, to a large extent the reuse of these assets can be gained by a mixture of organizational discipline and the use of some relatively mature technologies such as data dictionaries, database management systems, and version control software. Nevertheless, many researchers contend that larger savings can be obtained by the reuse of more abstract resources. This is because the cost of coding is generally only a small portion of the total development cost. At the most abstract level, experienced designers and programmers reuse internal "informal" software resources such as design and coding rationales learned from experience. The difficulty is gathering and representing this tacit, implicit knowledge so that others may benefit from it in their productive activity (Kim and Stohr, 1998). Thus, from our Intellectual Capital approach, the reuse of the most concrete software resources would be based mainly on the organizational capital, while the reuse of the most abstract software resources would be based mainly on social capital. We also assume the social capital solutions to be more effective in small units where everybody is in tight contact with the others, and the organizational capital solutions would become necessary for practical reasons when the unit size (and/or the complexity of the software) increases. Anyway, both of these methods must have their origin in the human capital system of the organization.

The software reuse through social capital is close to Schein's statements about learning. It seems (Schein 1997) that a great deal of the tacit cultural learning in an organization concerns persons' roles and past heroic deeds such as success in difficult tasks; mostly people know who has done something even if they do not know the details of what has been done. Since people use others as "external repositories" of information, they may provide answers to questions that are far beyond their own personal expertise. Thus a memory system of a group is larger than memories of its members. It develops over time and may be understood as a property of the group. The main stream of research on transactive memory is based to on the seminal work of Wegner (1986, 1995) who defines a transactive memory system as "a set of individual memory systems in combination with the communication that takes place between individuals." (Wegner, 1986), which represents a phenomenon close to the idea of social capital.

Some individuals may be recognized as experts in certain domains. In such a case they become responsible for encoding, storage and retrieval of any incoming information relevant to this domain. Other members of the group deliver new appropriate information (e.g. their own successful, innovative, pieces of code, or problems they themselves cannot solve) to them, thus storing this information externally in the experts. People may be recognized as experts on the basis of their personal expertise or as a result of circumstances in which they take responsibility for the information encountered by the group. Clearly, these processes

require that experts have been identified. In other words, this means people know who knows what. These "directories" are created and updated during the process of directory updating, but they cannot include the complete learned "sum" knowledge of the organization. Furthermore, all these processes require at least reasonably complete communication between members of the group.

Cohen & Levinthal (1990) and Helo & Kekäle (2006) claim that the work group-level learning is a path-dependent process. Cohen and Levinthal state that prior knowledge permits the assimilation and exploitation of new knowledge. This prior knowledge "should be closely related to the new knowledge to facilitate assimilation, and some fraction of the knowledge must be fairly diverse, although still related, to permit effective, creative utilization of the new knowledge" (1990:206). This idea is based on the preferred selection idea (Barabasi 2002) and the thoughts on transactive memory presented above: whenever a difficult task arises, any individual faces the options of either solving it by him/herself, or asking for help from somebody. In a system where the transactive memory of who knows what is effective and communication channels are well developed, the individuals tend to prefer asking for the person with the right kind of knowledge and skills for help, for the benefit of the project. If there are no mechanical code libraries or repositories, "lending" code from others very probably works in this way: the person who earlier has a working piece of code is recognized through either some kind of "expertise" list, either hard-copy or mental, or then through word-of-mouth on who has coded what in recent times.

However, only for the person who originally wrote the piece of code solves the problem based on his/her previous skills; the "reuser" typically gets only to work with the implementation problems. The learning of the original author of the piece of code becomes embedded in a way Cohen and Levinthal state (1990:136): he/she firstly learns by accumulating capacity to do the next similar task more effectively than the previous; but this accumulated capacity also makes him/her better suited to study intermediate or new but related technology advances, thus again accumulating his/her expertise in relation to that of the others. For the original problem stating person, the learning is of transactive memory character only. Similarly, persons who participate centrally in the definition of the product family ("domain analysers") identifying the platform model and identifying the allovable variations for each application will become the best (or often, the only) experts in product-line interfaces. This leads, over time, to centralization of knowledge about the most difficult tasks to few individuals in the organization in a power-law fashion. Thus, even in organizations where there is no computerized or paper-based code library, the members of the organizations start to use some of the more knowledgeable specialists as code repositories.

When the size of the organization increases, or the organization otherwise wants to improve the process e.g. against the CMM-i criteria, normally a systematic reuse process with a computerized library for the reusable software assets is built.

This leads us to analyze the software reuse through organizational capital, which represents the most explicit and systematic way to reuse the knowledge. It requires that the reuse is planned, that is, the organization develops explicit reuse processes and standards and, in particular, invests in the up-front development of reusable resources (Kim and Stohr, 1998). At this case, as these authors propose, software reuse can be seen as a clear process which includes several steps:

- Analyzing existing software resources to identify those that are suitable for reuse.
- Classifying and cataloging the identified reusable software reuse.

As result of these two steps, a library of software resources is developed. Furthermore, the following is needed:

- Specifying requirements for the new system.
- Retrieving appropriate reusable software from the software library.
- Understanding and assessing the functionality of the selected resources in order to use or modifying them.
- Modifying software resources, is necessary when the retrieved software resources do not exactly match the requirement specifications.
- Building new software resources is necessary when thera are no similar software resources in the software library for some requirements.
- Integrating the new and reusable software resources into the target software system

For Kim and Stohr (1998), there is a need to determine the most effective techniques in each of this phase of the reuse process and to develop an integrated and standardized approach that can be readily understood and adopted by a large community of software developers. Furthermore, the use of application generators in software reuse provides automated support for all the processes described. Thus, the idea of software reuse based on organizational capital is even clearer when the organization uses this kind of tools for software reuse.

The tools for making this process work include, except for the libraries/repositories, also tools to aid in the integration of the architecture, design and modifications, as well as configuration management tools to aid tracking the evolution of the product line (see e.g. www.scorpus.com, www.blacducksoftware.com, twitter.com/swreuse). Some pieces of software even can create new software by itself from the parameters the users choose (see Czarnecki and Eisenecker 2000).

In the case of such a computerized (or actually even a paper/file-based) code library, the library develops in quite the same way. Especially pieces of code that are used by common operations such as converting information between well-known formats, accessing external storages, interfacing with external programs, or general manipulations of information benefit from copying from a library that contains generic, well-tested pieces of software – but the library has to be acquired and configured, and the users must learn how to use the library, as well as what is in there. In order to make organizational capital by what has originally been individual human capital, the information must be stored in the libraries/repositories in "thick" (Geertz 1973:3-30) format, including usage details, change history and knowledge associated with the changes, context of applying the knowledge units along with the dependent software assets, as well as the knowledge units themselves. In ad-hoc repositories the specialist who has the code piece may reveal all these details when giving out the piece of code; in computerized libraries, he/she may not be available, or maybe not even alive.

To conclude, in both types, either ad-hoc (based on social capital) or systematic-processed (based on organizational capital) of software reuse, the human capital of the individuals is required. As Kim and Stohr (1998) state, even with a favourable climate and the best intentions, software reuse can be limited because it is difficult from a cognitive stand point. This applies to both the producers (who must understand the application domain) and consumers (who must understand the reusable resources before they can reuse them). Then, human information-processing capabilities are important deterrents to software reuse.

Figure 1 shows the two processes described.

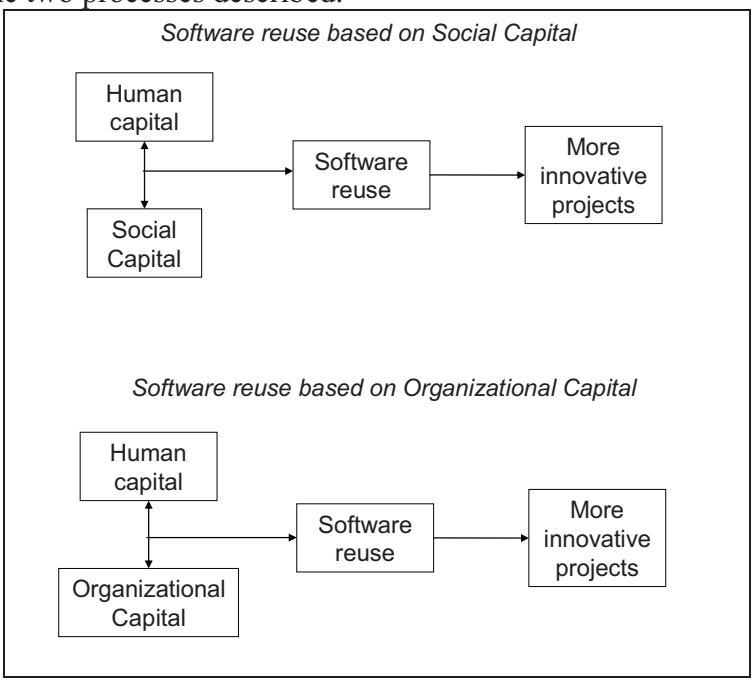

Figure 1. Software reuse based on Social Capital and software reuse based on Organizational Capital.

CASE 1: Ad-hoc "repository"

In a small software company "X" (that has since our intervention grown to a more than 100 persons through acquisitions, and also acquired software to aid code re-use) we noticed a very fine and typical ad-hoc knowledge reuse pattern when interviewing and modeling the activity in 2007. In small companies, especially when making relatively complex software to a multitude of customers, not everybody can be specialist of everything. Distributed knowledge in such a company typically refers to the situation when separate network actors bring different types of knowledge in the process (individual human capital), that allows the group as a group to accomplish difficult tasks in a flexible way. Further, people usually have through discussions, interaction etc. developed their own ideas of who knows what, that in other words can be called their cognitive perceptions of the knowledge networks of the company – or, by a more theoretical construction, social capital. These perceptions may be incomplete and/or inaccurate but they do exist, and should, according to theory, get more accurate over time when the common activity continues.

QuickTime™ and a
decompressor
are needed to see this picture.

Figure 2. Programmers asking for help from others to build code at "X" (the network is drawn here so that the "asking for help" goes from left to right, and the programmers who haven't asked, or haven't been asked, for help at east once a month have been left out; original N=40, but only 10 programmers were in the "frequent-contact network"). Legend: yellow line: about once-monthly request for help; red line: about once-weekly request; and black line, about daily request for help with the code.

The programmers who were working at X (40 engineers aged 20 and 34, all within the same physical premises in an open office floor partitioned by loose half-height cubicle walls) were asked to list the five colleagues that they most often asked for help in their tasks, and for each of these also to assess the number of times they requested coding help from these during a typical month. It turned out that asking for help was much less common occurrence than what was expected. Only a few persons "ever" had asked a colleague to help with difficulties in software programming (total N= 40, edge values relate to the number of times help was asked on average within a month; the 30 outsiders with edge value of 1 or less omitted in Figure 2). While this study was conducted without names, on request of the management at "X", we do not know for sure what kind of programmers asked whom for help; it might make sense that the persons requesting help might be the relative newcomers to the company and its product family at that given moment. However, in line with the previous theory, most of the events where programming help of some kind, such as ready-made modules or "earlier solution models" was needed included one of two "knowledge repository persons" at the company.

We then arranged for an interview with these two central persons in the expertise network. While the management again refused (for competitive reasons) to reveal the identities of the two, this interview was conducted by the secretary of the company according to our list of questions. Naturally, in such a setting, a complete thematic interview – that would have led us towards the "why" – was too difficult to arrange. However, even with this small-scale interview we managed to confirm that the solving of others' problems is a necessary source of increasing expertise. Individuals 5 and 7 stated that as much as between 10-20 % of their individual human capital (software coding skill) are solutions derived from solving others' problems, 40-50 % from their own previous coding, and the rest from their education (the answer alternatives for this question were for simplicity of analysis classified "none", "less than 10 %", 10 to 20 %" and so on).

Furthermore, another important finding in X was the unanimity of the other workers; it seems that a full 100 % of the "transactive memory", of the knowledge on who knows what and thus also the future preferences on where to find help (social capital), is due to the previous events where the experts have managed to help. No telephone books, knowledge catalogues, knowledge brokers or such were used in this smallish company. This would suggest that in an ad-hoc system, the organizational capital develops through the social stories, chats, legends and myths of organizational "heroes" precisely as culture is seen to be strengthened (Hatch 1993), and after that this informal organizational capital helps to strengthen the previous preferences on where to ask for help, which again at least to some extent leads to increased expertise among the preferred experts. Thus, in ad-hoc systems, the organizational capital seems to strengthen itself over time through the interaction of social capital and individual capital.

CASE 2: Systematic re-use process

Company Y was founded in 2000 for developing specialized software. Around that time interesting opportunities were emerging in the ICT sector in Spain, spurred by a new regulatory context that set the base for using the "electronic signature". With these new norms, there appeared to be an opportunity to promote also electronic public services that require a formal identification of the user.

Y was able to take advantage of this opportunity, and its founder and CEO created a very qualified team for developing this kind of software, mainly demanded by public institutions. Currently, Y has 50 employees. About thirty-five of them have a university degree, and the rest have some other type of computing qualification. The organizational structure is very flat and the culture rather informal. Under the CEO, there are just three levels: the project coordinators, the project managers, and the software teams.

The main niche for Ticsa is the electronic procedures connecting citizens with the government agencies, which require an electronic sign. Thus, most of the applications software developed by the company has many common elements. In this circumstances software reuse is a very valuable tool which allow to develop new applications very quickly, and to achieve an important advantage comparing to the competitors. Their systematic software reuse process assures that this potential become real benefits for the company. Nevertheless, the new applications obtained cannot be considered as high innovative, given they add new solutions to a basic structure common to all of them.

In this sense, the project coordinator interviewed highlighted the importance of the Applications Generator and the Software Repository. The success and productivity of building software is based on software reuse, and these tools make it possible. The accumulated experience on developing software in the company is stored in the Applications Generator (which is considered one of the most valuable resources in the company) and the Software Repository. As the project manager says, together they contain the main part of the collective knowledge of the company, which represents the organizational capital of Y. Along the next paragraphs, we describe the process of software reuse through the Application Generator.

Five years ago, two of the key employees (A and B) of Y originally built the Applications Generator. They are considered to be ones of the most qualified people in the company, and their high capability for developing new software is recognized by everybody in the company. So, as theory indicates, the origin of the knowledge is in the individual level. Programmers working in new applications can propose different kind of problems to be incorporated to the Applications Generator, and they constitute a list of proposals to be taken into account. Just the problems which could be present in the most of the applications developed by programmers should be incorporated to the Applications Generator, because it should include just the repetitive problems in the software development processes carried out by the company. Thus, some times, a certain discussion may take place among the programmers, through the Y's "Development Chat Line", about the advisability of including a new solutions in the Application Generator.

A and B finally implement the new solutions in the Application Generator, which provides a basic structure, useful for every new software which is being developed by some programmer. Furthermore, the Application Generator provides a methodology "to do things well", that is, it includes good practices to use the created solutions and to incorporate them in the software developed. The Application Generator has matured along its life. In the earlier time, a great number of proposals and an intensive informal process (collective discussion in the "development chat line") took place, in order to consider the advisability of including new solutions. Currently, the number of proposals and the level of informal discussion have diminished, because the Application Generator already include the most of repetitive

problems that may arise in the software development processes (the person interviewed told us that an average of one proposal at month is made by some programmer).

Parallel informal systems of software reuse are used in Y, similar to the described one for Company X. A free-flowing horizontal communication exists among the programmers proposing solutions to new problems which are not the kind of problems to be included in the "Application Generator". The Project Coordinator highlighted the willingness of the most of the programmers to share knowledge. Anyway, the key software reuse system for Y is based on its Application Generator, which represents a clear example of organizational capital.

We had defined organizational capital as the most explicit part of the knowledge, which to a certain degree can be expressed by codified documents. This knowledge expressed in several kinds of documents is very important for small IT companies, as Y is, in which very few people utilize very complex knowledge for developing new computing applications. Both for the colleagues (for whom this information can be very useful, in order to develop new applications) and the client institutions (which will be the users of the product), all the codified information about a new product is essential to reach the necessary knowledge. Specifically, for software reuse, Y follow a process much more systematic than company X and uses specific tools as application generators which provide automated support for this process.

Along the process of software development process in Y, is in the building phase where software reuse takes place. In this sense, the project manager interviewed highlighted the importance of the Applications Generator and the Software Repository. The success and productivity of building software is based on software reuse, and these tools make it possible. The accumulated experience on developing software in the company is stored in the Applications Generator (which is considered one of the most valuable resources in the company) and the Software Repository. As the project manager says, together they contain the main part of the collective knowledge of the company. At this point, the Application Generator in Y deserves attention as it reflects how the subcategories of intellectual capital interact.

One of the key individuals workers of Y originally built the Applications Generator. He is considered to be one of the most qualified people in the company, and his high capability for developing new software is recognized by everybody in the company. So, as theory indicates, the origin of the knowledge is in the individual level. Previous projects and solutions to different problems are incorporated constantly to the system, provided by individuals in the company. It is significant of the culture that people are willing to provide new solutions to be added to the system. At the same time, people also continuously demand solutions for new problems (Figure 3). Consequently, the communication and coordination among the people involved are also needed in order to optimize the advantages provided by the Applications Generator. Obviously the Applications Generator is a perfect sample of organizational capital, in which the knowledge generated within the firm is preserved, and structured recurrent practices are established.

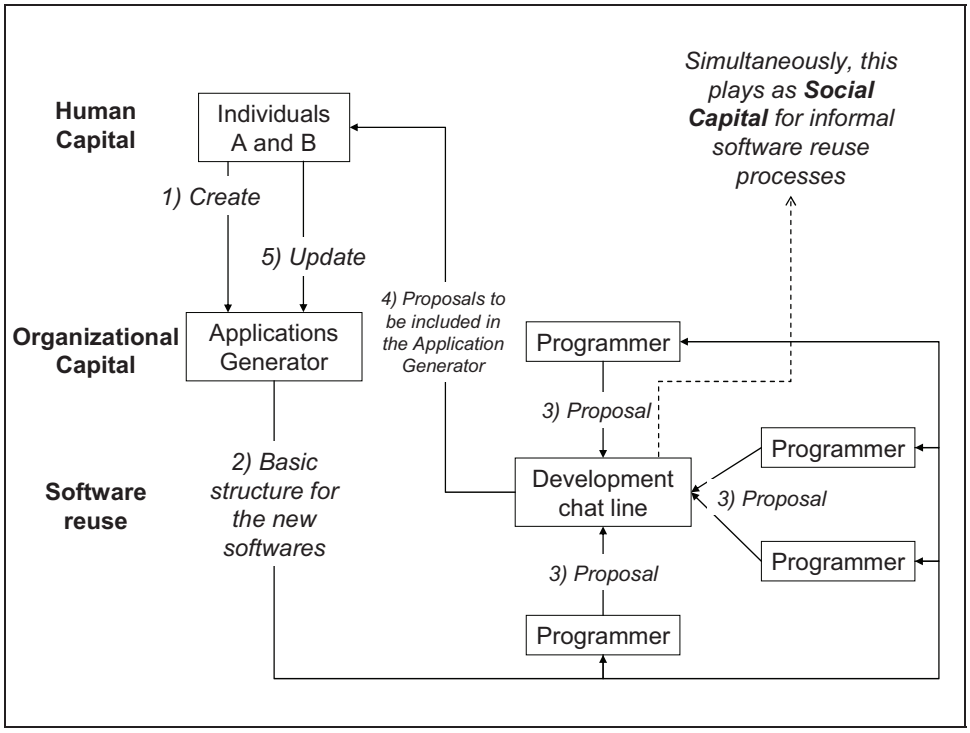

Figure 3. Software reuse through Application Generator at Y.

CONCLUSIONS

The two cases presented are quite similar to their sizes. The first company, X, however started by makng procts to anybody who was in need of embedded syetsms, while Y had a quite clear set of products in mind from the very beginning. Maybe this has been the reason why Y had a system in place while X did not. Our "ad hoc" case spreads human capital to organizational use through social capital, while our other case uses organizational-capital systems to spread the human capital and knowledge for software reuse. It may be difficult to state that companies always follow the path of developing reuse through ad-hoc social systems until at the size of about 50 persons (the size where also X went for code library systems); many other reasons should be tested in future studies. For example, the ad-hoc social capital reuse system could be suitable for small, young, one-location companies and software teams, or companies with very simple products; organizational capital reuse systems could again be more effective with more established, bigger, distributed, or with complex products.

To conclude, in both types, either ad-hoc (based on social capital) or systematic-processed (based on organizational capital) of software reuse, the human capital of the individuals is required. However, practical implementations seem to depend very much on the actual situation that can be a combination of the cases we suggest here, which could require combining human capital with either social or organizational capital or even with both; so, even code reuse, which would seem to be a very structurable activity, is clearly contingent.

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FACTORS PREDICTING SMEs' SUCCESS

Dr. Jiraporn Tangkittipaporn, Ph.D. (Management) *
tangkitt@chiangmai.ac.th

ABSTRACT

Globalisation of the economy and the accession to WTO have put strong pressure on Chinese government to revise many laws and regulations and also accelerated changes in its economics system. These may create new opportunities for Chinese SMEs to improve their business related performance. The purpose of this paper was to survey the actual business management competencies and investigate which factors contributed to the Chinese SMEs' business success. The results obtained from a sample of 338 SMEs located in Kunming, Guangzhao, Hangzhao, and Shanghai, helped to confirm that, in a transitional economy, most of the Chinese SME entrepreneurs exhibited a high level of business success and paid more attention to the sophisticated western style of management practices. When considering the most significant predictors for business success, it was found that the education level, human resources and marketing management competencies, financial liquidity, and types of trading were the significant predictors for business success. The concluding argument suggests that even Chinese SME entrepreneurs' management practices have changed to a better direction. However, SME entrepreneurs are still required to be equipped with new perspective, knowledge and skills of human resources and marketing management competencies to get the optimal business outcomes. To facilitate this situation, there should be an encouragement for financial assistance, international business incentives, community education and training.

Keywords: SMEs, Business management practices, human resource management competency, marketing management competency, education, financial liquidity, trading, business success.

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* Assistant professor, postgraduate program of Industrial/Organizational Psychology, Chiangmai University, Thailand.

INTRODUCTION

Small and medium-sized enterprises (SMEs) are an essential element for the world economy. Their practical procedures can make a positive contribution towards improving the economy, reduce unemployment and avert individuals into becoming a victim of poverty. SME promotion is, therefore, an essential function for every country around the world.

China is one of the countries recognizing the significance of SMEs to its economic system. From the start of 1978 and there on, the Chinese government has implemented an economic reform as well as an open policy. In 1979, the Chinese government began the establishment and the promotion of private enterprises (Hu, & Smallbone, 2004). The number of SMEs increased from 90,000 in 1989 to over 10 million in 2003, thus accounting for 99% of the total number of enterprises (data from website: china.com.cn, June 3, 2004). However, the critical issue of Chinese SME development and success is unclear and remains the subject of considerable debate.

The optimists argue that, after accessing to the WTO, the Chinese government has revised many laws, regulations, policies, and have implemented numerous changes in its economic system. The government has provided various incentive schemes for upgrading the business management systems and operations to enable private enterprises in gaining access to the competitive marketing (Kanamori & Zhao, 2005). This may help to enhance private SMEs' competence and organizational performance.

Further, the transitional economy changed the social origin of the SME entrepreneurs. At the early stages of the transition, the Chinese people were pushed to work in private enterprises or face poverty or unemployment. The private enterprises were composed of lower class and uneducated individuals. By 1988, national investigation showed that 32% of the private entrepreneurs were lower-middle class and 21% were lower class. Since 1997, 85.7% of private entrepreneurs belong to the middle class and upper middle class, only 4.2% of the private entrepreneurs are farmers (Zhang, 1994 cited in Roberts & Zhou, 2002)

The changes in social origin and globalization, as well as government promotion policies, developed encouragement towards private entrepreneurs to uphold the Western characteristics of seeking opportunities and taking risks to gain global market prospects, focusing on the quality of the product/service, developing management and technological expertise, and committing to a quality workforce (Hu & Smallbone, 2004). With the private sector continuing to reform and expanding, the Chinese SME entrepreneurs would upgrade their business management practices and equip themselves with higher skills to gain an advantage in the competitive world.

On the other hand, the pessimists argue that though Chinese SMEs in the transitional economy have many good opportunities, they also encounter numerous problems. Chinese SMEs are under strong pressure to upgrade the present level of technology and competencies for the purpose of competing in the local and foreign markets. Chinese SME development is limited by a number of constraints (Chen & Sun, 2002). They range from a lack of access to modern financing, marketing, gaining information and mentoring, establishing business premises, acquiring business competencies, all the way to coping with a poor infrastructure (Astrachan & Kolenko, 1996). Most of the Chinese SMEs are family-owned business and the management practices of the enterprises' are lacking in qualifications and ineffective (Chen

& Sun, 2002). Therefore, the enterprises rely largely on traditional management, ie., bureaucratic controls, low formalization, low quality control (Menkhoff & Kay, 2000), to secure personal loyalty and trust rather than seeking to improve their business management competencies and strategies to gain optimum productivity and profit. A number of constraints have been cited as major reasons for the underdevelopment and the failure of the private SME sector. According to the above limitations, about 80 percent of SMEs fail within the first five years of operation (Wijewardena & Cooray, 1995), and about 10-15 per cent of SMEs fail per year (Keasey, Savery & Watson,1991 cited in Blackwood, & Mowl, 2000). This business failure is both frequent and potentially damaging to the efficient operation of the world market economy.

To test whether the optimists' or the pessimists' argument is true for the transition economy, the purpose of this paper is, therefore, to first investigate the actual practices of business related performance to confirm whether the Chinese SMEs have been highly engaged with the western sophisticated management competencies and have exhibited high level of business success and vice versa. The second part of this paper is to identify the most significant predictors for their business success. It is expected that the results of this study will help to stimulate both Chinese and foreign SME entrepreneurs' awareness of the need to improve their management practices to optimize business outcomes.

SIGNIFICANCE OF THE RESEARCH

The proposed research outcomes not only assist in making recommendations for those involved in supporting the business systems in China and Thailand as well as for other countries to provide more appropriate business support services at a local level to strengthen SMEs' business atmosphere and competencies. The outcomes of this study is also for making a contribution to the awareness of improving entrepreneurs' contemporary management competencies to facilitate firm performance while reducing business barriers to reach optimal business outcomes and success.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

1. A profile of Chinese SME entrepreneurs' management competencies and business success

As mentioned in the introduction, I accepted the optimists' argument in that the changes in social origin and globalization as well as government promotion policies would help encourage Chinese private entrepreneurs to upgrade their own management competencies and being equipped with higher skills to obtain better advantages in a competitive world. Therefore, it was hypothesized that:

HYPOTHESIS 1

> *"Chinese SMEs entrepreneurs in the transition economy would be occupied with more western sophisticated management competencies and, therefore, exhibited a high level of business success."*

2. Factors Predicting Chinese SMEs' Business Success

There were numerous approaches in trying to explain the factors which have influence business success. The most popular approach is the Resource-Based View of the firm (Barney and Wright, 1998 cited in Barjargal, 2000). This theory postulates that there are three basic types of resources crucial for the success of SMEs. (1) The human-based resources is defined as the personnel demographic characteristics (gender, age, education, race, marital status), competencies (knowledge, abilities, skill), psychological attributes (motivation, creativity, initiative, innovation, entrepreneurial orientation, autonomy, commitment) and social relationships. (2) The physical capital resources refer to the firm's plant, equipment, technologies and finances. (3) The organizational capital resources include the firm's structure and management process, e.g., planning, organizing, co-ordinating, and controlling. These resources are assumed to influence business success through a firm's marketing and resource allocation strategies (McGivern & Tvorik, 1997).

Pena identified three categories of factors that are thought to influence the likelihood of business success: human capital, firm internal and external capital. Human capital involves the accumulation of personal attributes, i.e., competencies, experience, motivation, personality, health (Pena, 2002). Firm internal capital includes the age, size, technologies, equipment, structure, marketing strategy, management process and cultural pattern. External capital is related to network opportunities, public policies, tax incentives, industry-specific regulations, stability of economy, and the market potential (Katsikeas & Deng, 1997). The last two factors may impact business success by providing industry-specific advantages to the enterprises.

A considerable number of studies ranging from single case studies to comprehensive surveys explicitly confirm that business success is the result of a web of factors (Wijewardena & Cooray, 1995; Lussier & Pfeifer, 200; Frese, 2000). These findings show that they are not identical attributes that are conducive to business success due to the differences in definitions and scope of the terms (i.e., business success and the antecedents) that the authors defined as well as the limitations of samples' national culture and constraints (Yusuf, 1995). However, previous evidence supported that human capital, in terms of management competencies, is the most prevalent factor found to be critical for business success. This includes human resource management (Berryman,1983 cited in Blackwood & Mowl, 2000; Chen & Sun, 2002; Luoma, 2000), marketing management (Conant, Mokwa, & Varadarajan, 1990; Acar, 1993; Paige & Littrell, 2002), financial management (McMahon, 2001), and production management (Acar, 1993).

When human capital is compared to the firm contextual capital, numerous studies have indicated that human capital influence firm performance to a greater extent than firm contextual capital. For instance, Hansen and Wernerfelt examined a sample of 60 Fortune 1000 firms and advocated that industry variables eg., market share and firm size, represented 18.5 per cent of variance in firm performance while goal and human resources emphasis contributed 38 per cent of performance variance (Hansen & Wernerfelt, 1989). Aaby and Slater's study also confirmed that firm contextual capital has only minor influence on SMEs' business success (Aaby & Stanley, 1989).

Given this general orientation, It was hypothesized that:

HYPOTHESIS 2

"Among human capital and contextual capital, human capital in terms of management competencies, is stronger than contextual capital in predicting SME business success."

METHOD

1. Unit of Analysis and Respondents

The expected SMEs was drawn through purposive sampling of the cities and industrial location (Kuming, Hangzhou, Guangzhou, and Shanghai), and then used accidental sampling to get the target subjects. One hundred twenty questionnaires were distributed to each city, with the expectation of 70 returned cases per each. Locations that had questionnaires returned with less than 70 cases were redistributed to ensure that 70 cases were obtained. The total returned questionnaires were 338, representing a response rate of 70.41 per cent.

2. Measures

The questionnaires were grouped into three main categories: personal and firm contexts (17 items), western sophisticated management competenices (40 items), business success (5 items). All the items had closed questions, with different options for answers depending on the nature of the question, yes/no and 4-point scales.

Before studying with the Chinese SMEs, the research instruments were developed for studying with the Thai SMEs. The full versions of the Thai scales were shortened by cutting down some of the unnecessary items to suit the Chinese SME atmosphere and the current research time frame. A final translated version of the questionnaire was revised by the Chinese-Thai translators and then examined for discriminative validity by a t-test. The Cronbach's alpha coefficient of inter-item correlation was calculated for a reliability test. A p-value was 0.05 or higher to be acceptable as having significant discriminative power, while Nunnally's prescribed Cronbach's alpha of .70 was used as a guide for judging internal consistency (Nunnally 1978; Abramson and Ai, 1999; Paige and Littrell, 2002). The results showed high discrimination (12.526-20.790, $p<0.001$) and internal consistency (Cronbach's alpha = 0.705-0.904).

RESULTS

1. Basic Characteristics of the Sample

Approximately 69.5 percent (n=232) of the Chinese SME respondents were male. Respondents' average age was 33, with a range of 18-62 years old. Almost one-half of the respondents held graduate degrees (42.8%). The majority (75.9%) of the respondents had no religion and 54.5% were married.

The responding firms represented a wide variety of trading including retail, wholesale, and hybrid types of trading. Of these, 69.5 percent were small firms (with the employees less than 50) and 47.1 percent located in industrialized areas (Guangzhou and Shanghai). The firms

ranged in age from 1 to 10 years, with a mean of 5 years. Average registered investment was 1,396,000 RMB and the average number of full-time employees was 28. Approximately 75.9 percent of the participating firms had borrowed funds. The commodity products selected were clothing, footwear, wood, leather, jade & jewelry, handicraft, food, and computer. Mostly or 90.1 percent of the commodity products were sold with in the country and only 9.9 percent were exported abroad.

Table 1 Descriptive statistics for Chinese SME entrepreneurs' Business Success

Business Success	*Descriptive Statistics*			
	Poor/low n (%)	*Moderate n(%)*	*High n (%)*	*Total n(%)*
Firm performance	12(3.6)	**163(48.4)**	162(48.0)	337(100)
Future growth	15(4.5)	**175(51.9)**	147(43.6)	337(100)
Firm expanding trend	50(14.8)	126(37.4)	**161(47.8)**	337(100)
Satisfaction with firm performance	86(25.6)	**199(59.2)**	51(15.2)	337(100)
Self esteem of firm image	44(13.1)	**239(70.9)**	54(16.0)	337(100)
Overall business success	14(4.2)	**166(49.4)**	156(46.4)	337(100)

2. Profile of Chinese SMEs' Business Success and Management Competencies

Table 1 shows that only 4.2% of the Chinese entrepreneurs exhibited low level of business success (overall success score is between 1% - 49%), 49.4% of the Chinese enterprises exhibited moderate level of business success (overall success score is between 50% - 75%), and 46.4% of the Chinese enterprises exhibited high level of business success (overall success score is between 76% -100%).

Regarding the rank order listing for entrepreneurial management competencies, budgeting management competency was rank as the highest competency occupied, followed by human resource, marketing, and trade operation management respectively (Table 2).

Table 2 Descriptive statistics for Chinese SME entrepreneurs' management competencies

Management competencies	*Descriptive Statistics*				
	Min.	*Max.*	*M (%)*	*Sd*	*order*
Trade operation management	9	18	15.20 (76.02%)	1.98	4
Human resource management	10	20	16.41 (82.05%)	2.74	2
Marketing management	10	20	15.52 (77.61%)	2.40	3
Budgeting management	10	20	17.10 (85.52%)	2.40	1
Total Management	**41**	**78**	**64.23 (82.28%)**	**7.24**	

3. Factors Predicting Business Success

The predictive models for business success presented in Table 3,4 are presented in two forms: the "full" model and the "reduced" model. The full model (model 1) contained all predictive variables while the reduced model contained only significant predictive variables.

As show in Table 3, when all of 10 personal factors (gender, age, education, religion, marital status, job tenure, trade operation management competency, human resource management

competency, marketing management competency, and budgeting management competency) were included in the model as predictive variables. The reduced model (model 2) shows that human resource management competency (β=0.214, t=3.435, p<0.001), marketing management competency (β=0.141, t=2.227, p<0.05), and education level (β=0.115, t=2.008, p<0.05) were significant predictors. The set of significant predictive factors accounted for 12.0%, with a standard error of 1.87.

Table 3 Personal Predictors for Business Success.

Personal Predictors *(Dependent Variable: Business Success)*	**Standard Equation (Model 1)**		**Stepwise Equation (Model 2)**	
	β	**t-test**	***β***	**t-test**
(Constant)		4.852***		7.314***
Human Capital				
Gender (male & female)	.005	.091		
Age (young & old)	-.133	-1.676		
Education (low & high)	.105	1.864	.115	2.008*
Religion (religion & non)	-.062	-1.091		
Marital status (single & married)	.131	1.831		
Job Tenure	-.072	-1.184		
Trade operation management competency	.034	.515		
Human resource management competency	.213	2.837**	.214	3.435***
Marketing management competency	.105	1.565	.141	2.227*
Budgeting management competency	.017	.234		
Standard Equation: R = .381; R^2 = .145; Std. Error of the Estimate = 1.874; $F_{(10,275)}$ = 4.672, P=.000				
Stepwise Equation: R = .347; R^2 = .120 Std. Error of the Estimate = 1.878; $F_{(3,282)}$ = 12.828, P=.000				

β standardized coefficient; * probability <0.05; *** probability <0.001;
Model 1 standard predictive equation, containing all personal predictors;
Model 2 stepwise predictive equation, containing only significant personal predictors.

Table 4 Contextual Predictors for Business Success.

Contextual Predictors *(Dependent Variable: Business Success)*	**Standard Equation (Model 3)**		**Stepwise Equation (Model 4)**	
	β	**t-test**	***β***	**t-test**
(Constant)		12.040***		26.370***
Contextual Capital				
Location (non-industrialized & industrialized area)	-.014	-.222		
Firm size (10 log of number of employees)	.070	1.078		
Label language (Chinese & English)	.060	1.032		
Ownership (private & government)	-.138	-2.362*		
Registered investment	.056	0.939		
Borrowed funds (no & yes)	-.148	-2.564*	-.135	-2.375*
Types of trading (retail, wholesale & hybrid)	.093	1.500	.122	2.142*
Target market (within country & export)	.013	.212		
Business culture (Guanxi)	.048	.778		
Standard Equation: R = .241; R^2 = .053; Std. Error of the Estimate = 1.865; $F_{(9,295)}$ = 2.029, P=.036				
Stepwise Equation: R = .174; R^2 = .030; Std. Error of the Estimate = 1.871; $F_{(2,302)}$ = 4.717, P=.010				

β standardized coefficient; * probability <0.05;
Model 1 standard predictive equation, containing all contextual predictors;
Model 2 stepwise predictive equation, containing only significant contextual predictors.

Table 4 presents the models including only 9 contextual predictors (industrial location, firm size, firm label's language, types of ownership, registered investment, borrowed funds,

types of trading, target market, and business culture). The reduced model (model 4) shows that borrowed funds (β=-0.135, t=-2.375, $p<0.05$) and types of trading (β=0.122, t=2.142, $p<0.05$) were significant predictors. The set of significant predictive factors accounted for 3.0%, with a standard error of 1.87.

CONCLUSION AND DISCUSSION

The present findings help to confirm that there is a new profile of entrepreneurial competencies and success among Chinese SMEs in a transitional economy. Most of the Chinese SMEs exhibited high business success and paid more attention on western sophisticated management competencies. They ranked budgeting management activities as the highest frequent practices, followed by human resource, marketing, and trade operation.

Upon considering the significant predictors for business success, it was found that human resource management competency, marketing management competency, and the level of education were the most significant personal predictors, while financial liquidity (borrowed fund) and type of trading were the most significant contextual predictors for business success. It is interesting to know that the set of personal predictors has a stronger significance of influence on business success than the set of contextual predictors. Furthermore, even the Chinese SME entrepreneurs exhibited a high frequency of practice in budgeting management activities. However, it was not found to be a significant influencing factor for business success. Human resource and marketing management practices had stronger significant influence on business success. These findings are consistent with previous western modernized society's research findings. For instance, Lussier (1995) and Pfeifer (2001) found that human resource management or staffing, the education level, the use of professional advice, and planning had significant influence on small business success in both Central Eastern Europe and the United States of America. As for the set of contextual predictors, it was found that the financial liquidity and types of trading were the most significant contextual influencing factors for business success. This finding is also consistent with the foreign finding. For example, Yusef's (1995) study found that good management, the ability to access to financial resource, personal qualities, and adequate government support were the four most critical factors in successful small-business development in the South Pacific region (Melanesian Papua New Guinea and Vanuatu, Polynesian Western Samoa, the Micronesian Marshall Islands, and Fiji). Furthermore, Barjargal's study (2000) also supported that entrepreneurial versatility has a stronger and direct impact on Russian firm performance when it is in comparison to the general social (personal networks) and human capital resources (experience).

(1) The findings of these studies may help to confirm that the impacts of entrepreneurs' human resource & marketing management competencies, education and financial liquidity on business success have a universal value. However, in the reality of the business world, most of the SMEs are still encountered with the ignorance of the significant of human resource management practices. This experience may stem to the issue of the SMEs not having to deal with the labor unions (Marlow & Patton, 1993). Therefore, small and medium-sized firms have more freedom to manage their employees with little concern about human rights. This is confirmed by the study of Hsin, Kung, Chang, and Tam (1974). They found that Chinese small firms were production-oriented. In addition, the studies of Chen and Sun (2002) in China, Howe (1992) in Europe as well as Sim (2000) in Singapore also found that small firms are usually managed by entrepreneurs who are relatively inexperienced, as well as poorly

trained. Poor human resource management skills may result in poor personnel and asset allocation decisions, which may lead to job distress and malfunction. When the firms' entrepreneurs have less human resource management competencies, they will devote most of their attention to the liquidity of budget and the quantity of the products rather than to the quality of their employees. Yau (1994) advocated that the success of Chinese small firms is not solely influenced by marketing, but by doing favors for others. To be competitive, firms will require highly skilled, knowledgeable entrepreneurs and a relatively qualified and stable workforce. Firms achieve highly motivated and productive employees through effective human resource policy and practices which include recruitment, training, empowerment, motivation, utilization, and retention (Pfeffer, 1998). Various studies have suggested that inadequate and inefficient management of human resources has often resulted in low productivity, high dissatisfaction, and turnover among the employees (Mathis & Jackson, 1991). When the employees are poorly motivated, the employees' talent not only become wasted (Schuster, Morden, Baker, & McKay, 1997) but also decreases the firms' economic performance and limits business success (King, Solomon & Fernald, 2001).

(2) Marketing competencies in pricing, advertising, promotion, distribution, after-sale customer service, and sales force quality management is also recognized as the determinants of effectiveness of the firm's response to targeted market segments, as well as its access to alternative product/market positions (Conant, Mokwa, & Varadarajan, 1990; Acar, 1993). Marketing management competencies influencing business success through function as potential sources of increasing customers' satisfaction (Woodcock and Chen, 2000), sales growth and market share, which in turn increases shareholders' value by accelerating and enhancing cash flows, lowering the volatility and vulnerability of cash flows and increasing the residual value of cash flows (Srivastava, Shervani, and Fahey, 1998). According to Wijewardena and Cooray's study (1995), small business firms mostly failed within the first five years and the problem was mostly about the strategy and tactics of marketing (lack of a specific target market, site location, training of sales, distribution and advertising and merchandising or sales planning. Wu and Young (2002), Huang and Brown (1999 cited in Paige & Littrell 2002), Gilmore Carson, and Grant (2001) supported that small and medium sized enterprises (in China and other developing countries) have fewer marketing management competency and perceived marketing plan to be of little value in helping firm become successful. They do not comply with formal marketing strategies. Their marketing is likely to be haphazard, unplanned, loose, unstructured, and spontaneous. Several of these items have been previously proved as being important factors contributing to failure (Gaskill, Van Auken, Manning, 1993). To expand the Chinese economy, stimulate growth, and become successful enterprises in the 21st century, these Chinese enterprises have to be highly trained in marketing to carry out the capacity and be driven towards quality standard (Chen and Sun, 2002).

(3) The level of education for entrepreneurs' is one of the most cited personal demographic characteristic influencing business success (eg., Cooper, Dunkelberg and Woo, 1991; Judge, Cable, Boudreau, and Bretz, 1995; Pena, 2002). As noted by Useem and Karabel (1986 cited in Judge, Cable, Boudreau, and Bretz, 1995), the qualifications earned from formal tertiary education including scholastic capital (knowledge), social capital (personal contacts and network ties), and cultural capital (value and perspective) will enable the entrepreneurs to meet the demands of senior business executives. Higher education does not only help to stimulate entrepreneur undertaking formal business planning (Gibson, Brian, and Cassar, 2002) but also being exposed to key information and increasing their firms' aggressiveness in

marketing (Judge, Cable, Boudreau, and Bretz, 1995). In addition, formal education plays an important role with respect to entrepreneurial knowledge, ability and skill to access and adjust to external resources (Kennedy and Drennan, 1998) and to form the basis of analytical reasoning or rational response to problems. These education based characteristics are all important intangible assets for building successful firms through the development of entrepreneurial competences (Kiggundu, 2002).

(4) The role of financial liquidity (as measured by high or low use of outside borrowed funds) has been viewed as a critical element for the development of small and medium-sized enterprises (e.g., Isimbabi, 1990; Gaskill, Van Auken, and Manning, 1993; Gadenne, 1998). There are four reasons why sufficiency of financial leverage resulted in business success or failure. The first of these is management competencies. Firms with higher financial leverage or have lower use of outside borrowed funds may have the ability to enhance their management competencies which allow a business to be handled more appropriately and effectively (when the firm encounters problems, competencies help the entrepreneurs to select appropriate strategies to handle the situation). Lack of capital may inhibit the potential of entrepreneurs to hamper the growth of business and may finally cause failure (Isimbabi, 1990). Second, firms with higher financial leverage have higher investment capital for personnel development to gain competent personnel while firms with financial problems not only have no financial support for personnel development but also have no time for paying attention to personnel facilities. The entrepreneurs have to spend time in dealing with financial difficulties and find ways to solve the problems. Lower wages and facilities may induce to lower skills and performance. Third, firms with lower use of outside borrowed funds have higher purchasing power. Firms with higher investment capital can spend more money for purchasing stocks and products. These may result in an increasing of quality products but lowering the products' price (Dodge and Robbins, 1992). Fourth, firms with higher financial leverage can obtain advantages through better investment in marketing. Supplying products with higher quality and low prices can meet customer demand and satisfaction which finally generate profit for the firms. In contrast, firms that lack access to investment and working capital may prohibit the success of the business by choosing the dire alternative of acquiring poor supply of raw materials, lack of skilled labor, insufficient training, and having to cope with a poor infrastructure (Cook, 2001).

(5) Types of trading (retail, wholesale or hybrid trading) influence business success through financial resource, investment and marketing strategies. In comparison with hybrid and wholesale firms, retail firms are inferior with respect to both income and risk performance. Retail entrepreneurs often operate the firm at early stages of venture and start business with less capital and liabilities. Low capacity in assets and liabilities may induce the retail entrepreneurs to have a lower purchasing power to obtain lower invested prices. This also prevents them from building special relationships with financial resources to get a cheaper interest rate (Fink and Koller, 2002). On a desperate note, retail entrepreneurs sell the products in smaller quantities to individual customers (Alila, Odhiambo, Khayesi, and Pedersen, 2002). This may provide lower profit margins for the firms (Sim, 2000). Finally, low investment capacities may obstruct the retail entrepreneurs to develop internal resources and core competencies to meet marketing demands (Lawler, 1997). In contrast, higher capacities in financial resource, investment and marketing strategies may enable hybrid and wholesale entrepreneurs to have more influence on the competitive forces and gain more satisfaction with firm image and performance than those retail entrepreneurs having lower

experience and skills (Edwards and Royce, 2002) to sustain competitive advantages as well as facing credit rationing and higher financing cost.

IMPLICATIONS

The study may help to confirm that level of education, human resource and marketing management competencies are of utmost importance for SME business success. This evidences help to urge the Chinese and other countries' government to revise the education policy and pay more attention on improving SME entrepreneurial human resource and marketing management competencies and awareness to reach optimal business outcomes and success.

A better understanding of firm contextual constraints, specifically financial liquidity, will benefit policy makers, researchers, academicians and those involved in supporting business system to provide better financial assistance and a better learning process for improving SMEs' potential and international trade opportunity.

In addition, the government may need to provide some special tax withdrawal policy for the SMEs having human resource development. This may help to encourage micro, small, and medium-sized enterprise entrepreneurs to pay more attention to human resource's performance and quality of life.

Most importantly, the government and other related agencies may help the entrepreneurs to achieve their business success by developing business networking opportunities specifically for SMEs. This may help the SME entrepreneurs to gain both financial and information support to minimize "resource poverty" but increase "intellectual capital" to achieve business success.

At last, future research has to address the causality issues related to the constraints that limit SMEs' entrepreneurial competencies, financial liquidity, and international trade opportunity as well as ways for improvement to optimize the personnel's quality of work life and firm performance in both manufacturing and service providers.

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BEHAVIORAL AGENT-BASED MODELING OF STOCK MARKET MICROSTRUCTURE

Dr Mariusz Kicia
Maria Curie-Sklodowska University, Lublin, Poland
The College of Enterprise and Administration in Lublin, Poland
mariusz.kicia@umcs.lublin.pl

ABSTRACT

The research combines three approaches of agent-based modeling, behavioral finance and market microstructure. The results of simulations for experimental fundamentals-driven single stock market are presented. That can provide understanding of how single decisions may lead to increased market volatility, security price discovery or its mispricing. It is highlighted in the end how investors' confidence fall during a financial and economic crisis makes fundamental pricing not able to discover fair values of the stocks.

Keywords: agent-based modeling, stock market microstructure, fundamental valuation.

INTRODUCTION

Economists were one of the early adopters of digital computing for numerical solving problems that were hard or impossible to solve analytically. One of the first common uses of computer technology in economics concerned business processes optimization. As operations researchers learned to solve wide classes of optimization problems computationally, through so-called mathematical programming methods, economists were early users of such techniques for practical and policy problems. In 1960s and 1970s, database technology, programming languages development and the first artificial intelligence systems made it possible to implement effectively numerical methods to estimate macroeconomic models and large amount of data processing (Axtell 2008).

The origin of multi-agent systems within computer science in the 1990s made an important, expected and permanent connection between distributed artificial intelligence, object-oriented programming and game theory to create a new powerful approach of agent-based simulation and complex systems modeling. In agent-based modeling (ABM), real-world systems are modeled as collections of autonomous decision-making entities, called agents. Each agent individually assesses its situation and makes decisions based upon its own set of rules. Model simulations are run hundreds or thousands times to generate distribution of behavior. That behavior may be confronted with real historical data to measure its calibration. In 1999, the NASDAQ stock market used BiosGroup software to simulate the impact of proposed regulatory changes on the financial market, especially in a tick size (minimal change in security price) from 1/8 USD through 1/16 USD to final decimalization (1/100 USD). Computer application created orders of thousands of individual investors, fund managers, day-traders and other market participants. Everyone made decisions of buying or selling securities on the basis of real market rules (Darley, Outkin 2007). ABM approach allowed to observe interactions between individuals and identification of phenomena that would never be explained by mathematical models. Using ABM methods, Macy's chain

designed shopping centers, Hewlett-Packard analyzed impact of employment strategy on organizational culture, and Société General made projection of operational risk in assets management process.

Agents modeled with ABM approach are not expected to be fully rational. There is an incredibly long list of phenomena which, while inexplicable with the standard tools and approaches of mainstream economics, have found a satisfactory explanation in behavioral approach. Behavioral finance rejects the vision of economic agents behavior based on the maximization of expected utility. Both, controlled experiments and real life situations prove that the assumption of rationality is too strong and unreal to explain some decisions and actions. Behavioral finance cannot be looked upon as coherent and uniform theory of human behavior, but still as a set of discoveries concerning simplistic ways of thinking (heuristics) and biases people have in their minds while making decisions. And since financial decisions are nothing more but a specific kind of decisions people make, investors are also exposed to heuristics and biases. Psychology of finance, originated as an answer to numerous anomalies of market effectiveness and now it is becoming a separate field of the capital market research. Its significance was appreciated by awarding Prof. Daniel Kahneman the 2002 Nobel Memorial Prize in Economic Sciences. Nowadays research on behavioral finance is being provided all over the world.

One of the interesting approaches is explaining market complexity by defining or simulating single market participants and interacting their decisions through the study of markets organization and function, or market microstructure. Most of the literature in this area focuses on the two central roles of markets - the transfer of ownership and price discovery. Research on the former role emphasizes the costs of trading (liquidity), while research on the latter emphasizes the process by which private information is incorporated into prices. Security market microstructure became the matter of interest in the late 1960's. One of the significant researchers of market microstructure, Prof. David K. Whitcomb (Professor of Finance Emeritus, Rutgers University, NJ; the founder and chairman of Automated Trading Desk, Inc., the first expert system for fully automated limit-order trading of common stocks) in 1981 analyzed relations between the bid-ask spread and the formulation of optimal investor trading strategies (Cohen, 1981). In another research dedicated to the problem of market liquidity analyzing relations between the bid-ask spread and the expected securities returns proved that reduction of the bid-ask spread leads to substantial increase in assets prices (Amihud 1996). The same authors, together with Beni Lauterbach examined the value effect of transferring stocks from a daily call auction system to a continuing trading mechanism (Amihud et al. 1997). Similar effect at Paris Bourse, existing after stock transfers, was shown by Chris Muscarella and Michael Piwowar (Muscarella 2001). Sang-Gyung Jun, Achla Marathe and Hany Shawky confirmed positive correlation of market liquidity and stock returns observing liquidity at 27 emerging markets from 1992 to 1999 (Jun, Marathe, Shawky, 2001).

The research presented in the article combines three above approaches of agent-based modeling, behavioral finance and market microstructure. First, a heuristic model of fundamental stock valuation is proposed. It is assumed that some of market participants are able to assess the fair value of the stock and start fundamental trends. Other market agents (quasi-rational behavioral investors, chartists and noise-traders) are involved in the fundamentals-driven experimental single stock market. All investors behavior rules (strategies) are explained. Findings in the field of stock market microstructure explain how investor's orders lead to transactions and price discovery, which makes them very close to the practice of investment. Including behavioral aspects in the market structure mainstream of the

research, especially behavior of quasi-rational investors, seems to be interesting. Agent-based modeling makes it possible to observe interactions between the investors both rational and irrational; individual and institutional; with short and long investment horizons. Computer technology allows to create model simulating real processes with growing number of variables, for example, a model of the security market that would be an effect of transactions of individually modeled but existing in the same exogenous conditions investors (agents). It is an interesting perspective to have the ability to compare how would the market react to the specific information depending on the market structure of investors.

The results of multiple simulations can provide better understanding of how single decisions may lead to increasing market volatility. Simulations in different market structures can show why patterns of reaction to the information are different in developed and developing markets. Behavioral agent-based modeling results is a realistic simulation of a system because it emulates the manner in which the world really operates. Even a simple model can exhibit complex behavior patterns and provide valuable information about the dynamics of the real world in the way other methods can never provide.

A HEURISTIC MODEL OF DCF VALUATION

Consider a single security market. Assume that the market consists of two sets of agents: fundamentalists and behaviorists. Agents with a fundamental invest attitude will buy a given security only if its market value is less that the fundamental value is not constant in time and depends on financial statement information that are available or expected by an agent. Suppose that a fundamental investor is able to assess a security value using the most commonly used valuation method of Discounted Cash Flows (DCF). Assume that all the fundamental agents are not fully informed on security issuer future financial condition and they only approximate a fundamental value at every moment using some simplification in calculations.

The practice of the financial market agents justifies such an approach. One of the most known Polish fundamental stock market investor, Zbigniew Jakubas, major shareholder of some Polish Warsaw Stock Exchange (WSE) companies, whose assets are estimated at 1 bln PLN (300 mln USD or 0,1% of Poland GDP in 2008; number 30. at the Most Wealthy Poles List), often glorifies benefits of his simple investment strategy. He considers buying a company only if the current capitalization to last year EBITDA ratio is no less than 2-3 and selling if it is higher than 6-7. The ratio mentioned in not the ultimate decision factor but the strategy is worth considering.

Let us define the DCF value of the company as the sum of discounted free cash flows (*FCF*) expected within next subsequent *n* periods and residual value (*TV*) which is the sum of the cash flows expected to be generated from *n+1* period to infinity. Let *g* denote a growth rate of the *FCF* in residual period and *WACC* denote waged average cost of capital used as a discount rate. The DCF value is given by the equation (1):

$$EV = DCF = \sum_{t=1}^{n} \frac{FCF_t}{(1+WACC)^t} + \frac{FCF_n \cdot (1+g)}{(1+WACC)^n \cdot (w-g)} \qquad (1)$$

Free cash flows generated by the issuer in a given period is a sum of an operational profit (*EBIT*) less adjusted taxes paid with *t* interest, increased by depreciation value (*DEP*) and decreased by capital expenditures (*CAPEX*) and working capital investment (ΔWC):

$$FCF_t = EBIT_t \cdot (1 - t) + DEP_t - CAPEX_t - \Delta WC \tag{2}$$

Suppose that agents have no detailed information on capital investment but they assume that the amount of the capital expenditures is equal to depreciation which means that in a long time a company will depreciate all the fixed assets it holds.

$$DEP_t = CAPEX_t \tag{3}$$

Simplifying assumption given by (3) allows to define *FCF* as:

$$FCF_t = EBIT_t \cdot (1 - t) - \Delta WC_t \tag{4}$$

Change in company working capital is a consequence of changes in inventories, short term receivables and short term liabilities:

$$\Delta WC_t = \Delta INV_t + \Delta REC_t - \Delta LIA_t \tag{5}$$

Suppose that agents are able to calculate realized lengths of inventories, receivables and liabilities restoration cycles (c_{INV}, c_{REC}, c_{LIA} respectively) and using sales expectations calculate the demand for working capital (5) with (6), (7) and (8), where SALES denote total revenues received by issuer and r is a sales and EBIT growth rate.

$$\Delta INV_t - INV_t - INV_{t-1} - c_{INV} \cdot \frac{SALES_t}{365} \cdot \frac{r}{1+r} \tag{6}$$

$$\Delta REC_t = REC_t - REC_{t-1} = c_{REC} \cdot \frac{SALES_t}{365} \cdot \frac{r}{1+r} \tag{7}$$

$$\Delta LIA_t = LIA_t - LIA_{t-1} = c_{LIA} \cdot \frac{SALES_t}{365} \cdot \frac{r}{1+r} \tag{8}$$

Suppose agents expect the operational cost structure of the company valued to be stable during the analyzed period. That makes EBIT to revenues margin to be constant and equal to ratio observed in the last financial statement (9).

$$m = \frac{EBIT_0}{SALES_0} \tag{9}$$

Completing (4) with (5), (6), (7), (8) and (9) gives:

$$FCF_t = EBIT_t \cdot \left[(1 \quad t) \quad c_{INV} + c_{REC} - c_{LIA} \cdot \frac{r}{1+r} \cdot \frac{1}{m}\right] \tag{10}$$

If we assume that α is equal to (11):

$$\alpha = (1 - t) - \frac{c_{INV} + c_{REC} - c_{LIA}}{365} \cdot \frac{r}{1+r} \cdot \frac{1}{m} \tag{11}$$

then (1) using (10) and (11) can be denoted as:

$$DCF = \alpha \cdot \sum_{i=1}^{n} \frac{EBIT_i}{(1 \mid WACC)^i} + \frac{FCF_n \cdot (1+g)}{(1 \mid WACC)^n \cdot (w \quad g)} \tag{12}$$

Assuming that revenues, EBIT and operational costs grow with the same constant rate r, we can define DCF enterprise value (EV) as:

$$EV = DCF = \alpha \cdot EBIT_0 \cdot \sum_{i=1}^{n} \frac{(1+r)^i}{(1+WACC)^i} + \frac{EBIT_0 \cdot \alpha \cdot (1+r)^n \cdot (1+g)}{(1+WACC)^n \cdot (WACC - g)} \tag{13}$$

Given (13) we finally define a ratio of enterprise value to last $EBIT$ as:

$$\frac{EV}{EBIT_0} = \alpha \cdot \left\{ \frac{1+r}{WACC - r} \cdot \left[1 - \left(\frac{1+r}{1+WACC} \right)^n \right] + \frac{(1+r)^n \cdot (1+g)}{(1+WACC)^n \cdot (WACC - g)} \right\} \tag{14}$$

The equation given in (14) is a quite simple to calculate parameter, using not only the past performance of the company, but also including the future expectations of the issuer fundamental parameters both microeconomic (r, m, g, c_{INV}, c_{REC}, c_{LIA}, $WACC$) and macroeconomic (risk-free rate and risk premium in $WACC$). The fundamental investment strategy proposed by Zbigniew Jakubas means buying when value of (14) is greater than V_{MIN} but smaller that V_{MAX} and selling below and above those limits.

It is interesting to check the performance of the multiplier at the real stock market. The given above procedure of heuristic DCF valuation ($HDCF$) was implemented to stocks listed at WSE. Below are example results for two companies: ALMA MARKET S.A. (ALM), a network of delicatessen and MIESZKO S.A. (MSO), a confectionery producer.

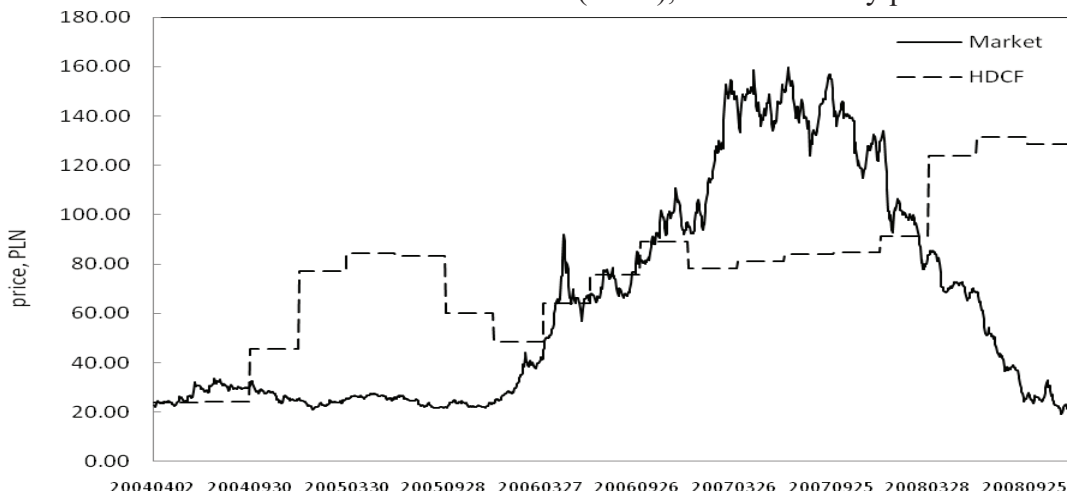

Fig 1. Market price and HDCF valuation price for ALM

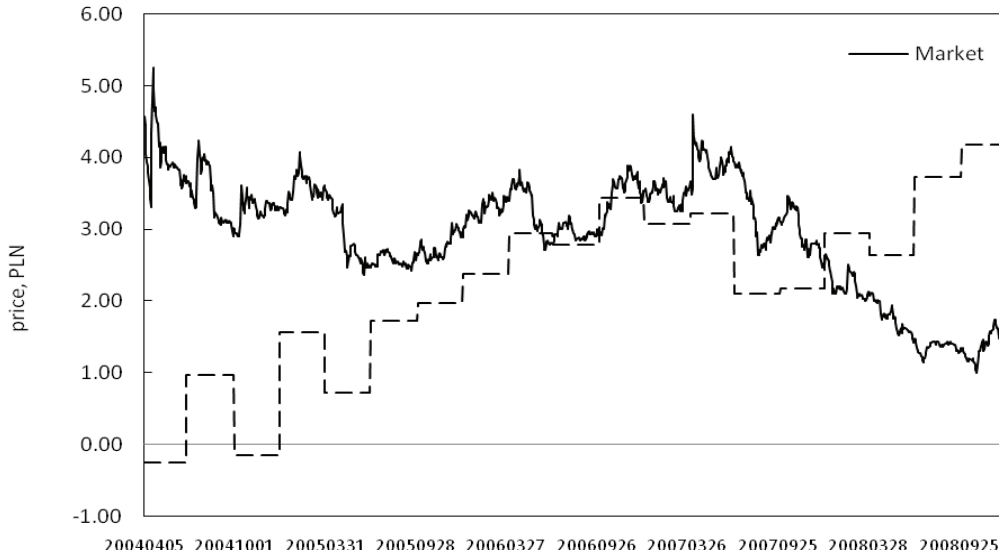

Fig 2. Market price and HDCF valuation price for MSO

The fundamental values for both companies were calculated with data provided in companies quarterly reports for 2004Q1 to 2008Q4. The *HDCF* values assumed that fundamental parameters observed in the last 4 published quarter financial statement would be constant within next 5 years (projection period). WACC were calculated upon current WIBOR3M (Warsaw Interbank Offer Rate) as a risk-free rate, 5% risk premium and beta equal to 1. Corporate Income Tax rate was constant at 19%. Fig. 1 and 2 present HDCF and actual market price of ALM and MSO during 2004Q1 to 2008Q4.

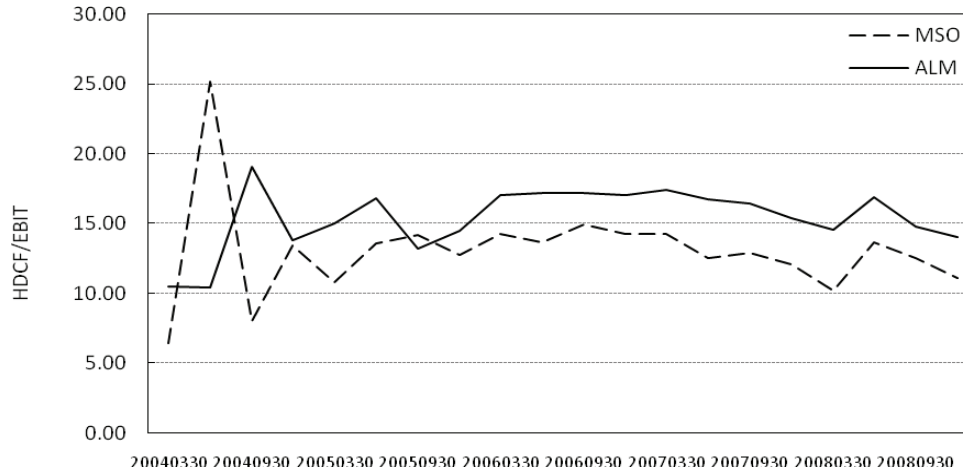

Fig. 3. HDCF/EBIT ratio for ALM and MSO

Fig. 3. presents changes in HDCF/EBIT ratio for analyzed securities. It shows that in both cases level of about 15 for the indicator can be observed when market prices of stocks reach their fundamental values. Benefits of the PRICE/EBIT ratio can be shown, when actual market price is taken to calculate it. The effects presented at fig. 4 and 5 justify Zbigniew Jakubas fundamental strategy.

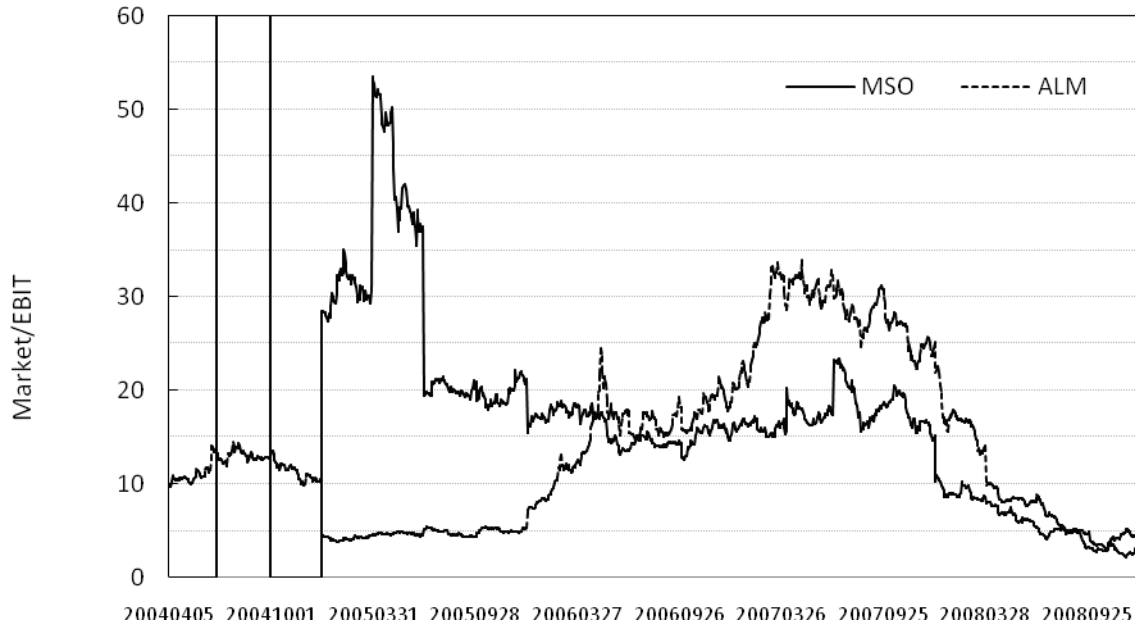

Fig. 4. Market/EBIT ratio for ALM and MSO

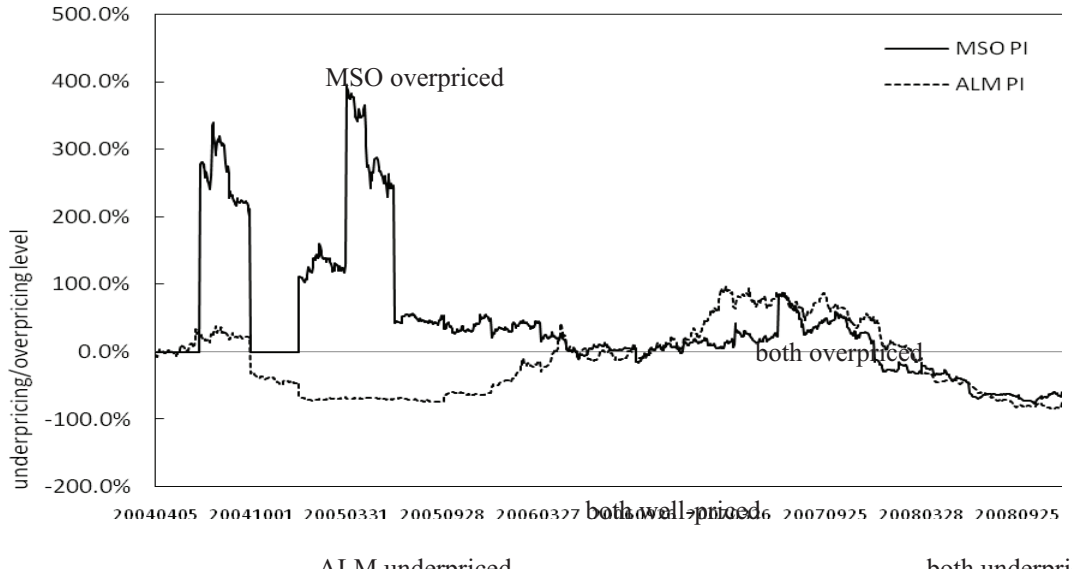

Fig 5. Underpricing/overpricing level for ALM and MSO as a difference between market and HDCF price

As we can see from above the level of fundamental mispricing observed is strongly connected to EV/EBIT ratio. The results show that 15-20 may be considered as the level comprising fundamental value for ALM and MSO shares. The initial research made by the author also shows that in most cases a level of 10-20 can be assumed for WSE listed companies. Fig. 6 shows the HDCF/EBIT sensitivity to *r* and *g*, at the commonly assumed in Poland 8% level of WACC.

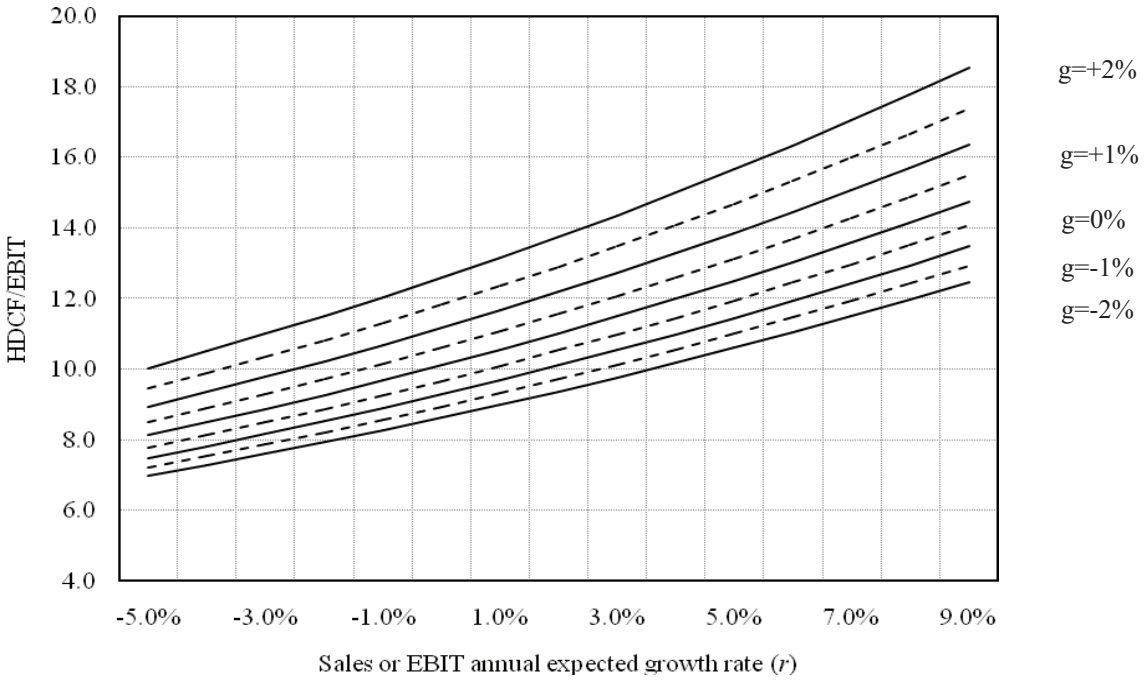

Fig. 6. HDCF/EBIT multipliers depending on EBIT expected growth rate (r) and residual growth rate (g) and 8% WACC level

Finally, let's assume that the fundamental agents operating at the experimental stock market decide to buy stocks if the market price is below HDCF and sell them if the price is above. Suppose beside the commonly observed parameters (EBIT margin, working capital cycles lengths, WACC), expected growth rates follow $g \sim N(g_0, \sigma_g)$ and $r \sim N(r_0, \sigma_r)$. As we observe, the fundamentals may explain only some rational changes in stock prices level but the market consists also of irrational or not informed agents.

EXPERIMENTAL MODEL OF FUNDAMENTALS-DRIVEN STOCK MARKET

There is only one virtual stock available at the market and the fundamental value of the stock can be assessed by HDCF model described above. All the information necessary for HDCF valuation can be easily collected (deterministic variables) or assumed (stochastic variables) by agents who follow a fundamental strategy in investing and are unknown or unnecessary for all other agents. Each virtual day of trading every agent can decide to buy, sell a share of stock, or do nothing depending on his strategy. Agents issue a orders with limit price. Every order is stored in a book until it is filled or cancelled if it is not filled within 5 virtual days of trading. During the single day transaction are settled until there are no more matching orders.

Suppose there are four categories of investors at the market: fundamentals, chartists, behavioral investors and noise traders. In case of low liquidity market makers also appear and issue buy or sell orders. Every category of investors except market makers is represented by equal number of market participants. It is assumed that there is one market maker that begins trading when demand and supply become unequal. Except for the market makers short-sale is

unavailable. Starting the simulation half of every group is equipped with a given number of stocks and the other half is only observing the market to buy stocks in the future.

Fundamentals. Fundamentals may issue buy order only if HDCF price is higher than the market price at the moment and may sell it otherwise. In every period not all but only some fundamental agents are randomly allowed to act at the market (Shimokawa, Suzuki, Misawa 2007). HDCF valuation changes when new financial statements are announced. Investors recalculate the fair value of stocks traded with parameters of r, m, g, c_{INV}, c_{REC}, c_{LIA}, $WACC$, risk-free rate and risk premium. Expected growth rates follow $g \sim N(g_0, \sigma_g)$ and $r \sim N(r_0, \sigma_r)$. Other parameters are commonly observed and the same for all the market participants.

Chartists. Chartists decide to issue buy or sell orders depending on Relative Strength Index value and 5-day return. Following strong growth period (more than 10%) part of the chartists are allowed to issue buy orders (trend-followers) while the other part is considered to be contrarians and issues sell orders. After the deep fall period (more than 10% in 5 days) trend-followers try to sell the stocks they hold and contrarians begin to issue buy orders in hope of mean-reversion.

Behavioral investors and noise-traders. 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 uses 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).

Behavioral investors in the experimental market buy or sell stocks assuming the trend to last. For every single virtual day investors calculate expected stock prices at t+20 periods ahead depending on simple linear regression estimated with the last 20 closing prices which in practice means a intuitive graph extrapolation of the trend. If the expected price is lower than the market price stocks are sold if possible or nothing is done if investors holds no stocks. If stocks are traded below the expected price investor issues buy order. And finally, noise traders issue buy and sell orders with the random prices near best buy and offer orders in the book.

RESULTS AND DISCUSSION

The experimental market was simulated for hypothetical N=1200 days for ALM stocks. Fig. 7 presents two examples of market price changes process with normal parameters of HDCF valuation procedure and panic parameters caused by world financial and economic crisis strongly affecting market prices of WSE traded stocks starting from 3Q-4Q2007.

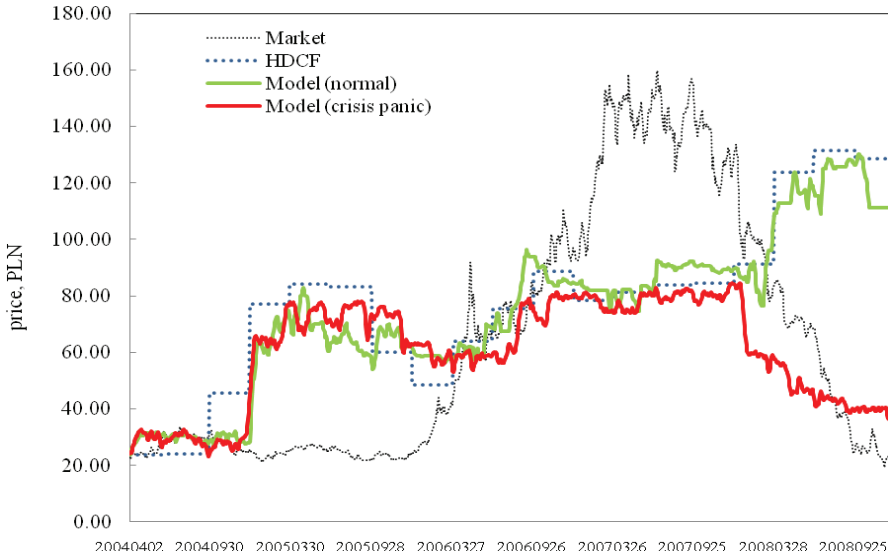

Fig. 7. Market, HDCF and examples of experimental ALM prices with normal conditions and financial crisis low sentiment

The experimental market behavior is an outcome of the rules by which agents make decisions, the principles by which agents issue their orders and the mechanism by which agents learn or evolve (Liu, Gregor and Young 2008). The most important power of simulated market was the fundamental value of the stock and behavior of fundamental investors. During the experiments with different market microstructures of investors categories is was confirmed that the necessary condition for the market mechanism to discover the fair value of the stock is that there will be large enough group of investors with fundamental strategy and ability to assess the fair value. If there was a relatively small group of fundamental agents active at the market with chartists or behavioral agents dominating the market trends were approaching the fair value of the stock only accidentally. It was also proved that for the market defined as above lack of noise-traders will provide higher liquidity risk and long periods without transactions especially when market makers were not active at the market.

The purpose of the experiments was also to confront behavioral aspects of investors' decisions by their influence on price settlement with actual market price of the stocks. It is confirmed that information on fundamental value of the stocks is not enough to explain market price behavior since it can be detached from the fair value. Although, at least in case of ALM stocks, fundamental valuation can be helpful in building a successful long term investment strategy.

Fundamental strategy effectiveness is unfortunately decreased during the periods of low market sentiment caused as from half of 2007 year by world financial and economic crisis. The HDCF valuation does not explain such a strong decrease in ALM stocks market value. Contrary, in normal conditions fair value of the stock should have been rising instead of continuing falling. Moreover, the same level of underpricing often without fundamental

reason concerns most of Polish stock exchange traded companies. The main WSE index, WIG20, lost almost 67% of its value from the middle of 2007 (about 3900 points) to beginning of 2008 (about 1300 points). Of course, if we consider ALM market and fair value, we can see a strong overvaluation during 2007, a year of strong economic growth for Polish GDP. Even in 2008, when USA and EU announced a pending recession, Polish economy ended with almost 5% dynamic of GDP. The fundamental parameters do not explain such a strong reverse. But if we consider that the effects of world crisis are widely discussed also for Polish economy and companies, consumer confidence and business activity fall and risk-aversion rises due to lack of free capital, fundamental pricing becomes more heuristic than before and explains market overreaction. ALM HDCF valuation based on data from the 4Q2008 and market parameters is about 94 PLN (26 USD). If we lower EBIT margin to -5% (from almost constant 4-5%), sales annual growth to -10% (from 7-9%), residual growth to -2% (from 1%) and rise WACC to 12% (from 7-8%) according to risk-aversion, ALM HDCF price falls to 26 PLN (7,25 USD). The market price at the end of March 2009 for ALM was about 18-20 PLN. The same assumptions for MSO stocks lowers its HDCF value to 3,90 PLN, small but still high above the market price of 1,20 PLN at the end of March 2009.

That is a part of the process that happened in reality. The wide panic stocks sale out by individual and institutional investors in Poland that took place in 2007 and 2008 made the falling trend stronger and was confirmed in simulation when "panic factor" was involved in the HDCF model and fundamentals decisions by changing parameters mentioned above. Not only fundamentals reverted their positions but also trend-followers, chartists, behavioral and noise-traders.

CONCLUSION

The research presented in the article combines agent-based modeling, behavioral finance and market microstructure approaches. First, a heuristic model of fundamental stock valuation was proposed (HDCF). Examples of HDCF valuation for Warsaw Stock Exchange companies were presented showing that in steady market conditions fundamental value may be a main but not the only force to change market prices. It is assumed that participants who are able to assess the fair value of the stock start fundamental trends and price correction in a long time. Including behavioral aspects in the market structure. The results of simulations for experimental fundamentals-driven single stock market were presented. The model can provide understanding of how single decisions and strategy choice may lead to all market volatility. It is highlighted in the end how investors' confidence fall during a financial and economic crisis makes fundamental pricing not able to discover stock fair value.

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MODELING THE EVALUATION OF BUSINESS STRATEGY

Chinho Lin, National Cheng Kung University, Taiwan, R.O.C.,
linn@mail.ncku.edu.tw

Hua-Ling Tsai, National Cheng Kung University, Taiwan, R.O.C.,
r3897107@mail.ncku.edu.tw

ABSTRACT

In today's ever-changing business environment, it is imperative for a firm to be able to dynamically adapt to the changes in order to maintain and/or enhance its competitive advantage. Therefore the evaluation and selection of the best business strategy, given the company's limited resources and capabilities, could be a vital task. Due to the uncertainty and dynamics of the business environment, previous research in strategic management has mainly focused on using qualitative research methodology to understand the process of forming business strategy. In this research, we propose a comprehensive quantitative model for business strategy evaluation. The study first reviews the literature in resource-based theory and value chain analysis to identify important factors in making business strategy. A fuzzy multiple criteria decision-making technique is implemented that combines both the empirical data of the firm and experts' subjective opinions to automatically rank and evaluate the degree of fitness of different business strategies. To demonstrate the applicability of our model, we apply it to analyze the fitness of the four business strategies in Miles and Snow typology. The model integrates factors related to both environmental uncertainty and industry attractiveness and facilitates firms to formulate the strategy through a more holistic and objective perspective.

Keywords: Miles and Snow typology, strategic management, fuzzy theory, strategy classification system

INTRODUCTION

Strategic management as an academic field is relatively young comparing with other fields of business. Research on strategic management and organizational theory has made significant progress during the last few decades. The early development of business strategy is primarily due to the work of Alfred Chandler and others at Harvard Business School. Chandler (1962) and Ansoff (1965) defined corporate-level strategy as a match between the organizational strengths and weaknesses within the universe of environmental opportunities and threats. Corporate-level strategy helps a company to determine what business it should be in. One problem with the applicability of their works is the lack of systematic procedures to help evaluating the fitness of the strategy. An important breakthrough in the field of strategy was developed by Porter (1980). He pointed out that the structures of an industry were determined by the conditions and competitions within the industry. The business-level strategy helps a company to find out how it should compete in a given line of business. Wernerfelt (1984)

extended Porter's model by considering the endogenous resource and capabilities of the companies. The resource-based approach built on combining the internal analysis of the firms and the external analysis of the industry, and was considered a powerful approach to help selecting suitable business strategies. The strategic management field has gone through a period of rapid growth during the subsequent two decades and since was considered a more matured discipline. Nag, Hambrick, & Chen (2007) recently performed a large-scale survey of strategic management scholars and derived an implicit consensual definition of the field. Their findings suggest that "*strategic management's success as a field emerges from an underlying consensus that enables it to attract multiple perspectives, while still maintaining its coherent uniqueness.*" It can be evidenced by more and more scholars with different background of training and expertise to join the field of business strategic management (Nerur, Rasheed, & Natarajan, 2008). Strategic management is a multi-disciplinary field that encompasses from economics to organizational theory, and is also closely related to the development of enterprise. There are increasing interests from both researchers and practitioners in the field of business strategies (Boulianne, 2007; Lin & Tseng, 2006). Firms are under the rising global competition and ever evolving business environment changes. It is vital for a firm to thoroughly understand the effects and interactions between uncertain business environment and organization capabilities in order to enhance the performance of the business strategy implemented. Superior performance often depends on the quality and consistency of the firm's strategic orientation, and a right business strategy would help in achieving the organization's goals and objectives (Casey, 2004). Therefore, one of the critical tasks faced by a firm today is to maintain sustainable competitiveness through utilizing effective techniques to help selecting the right business strategy.

The extant research in strategic management has mostly adopted qualitative research methodology that collected data to explore the relationship between strategy measurement and organizations' performance using questionnaires and/or in-depth interviews (e.g., Gaiardelli, Saccani, & Songini, 2007; Pinto & Curto, 2007). In this research, we propose a quantitative method based on fuzzy membership functions to evaluate and rank the appropriateness of the four basic strategy types of Miles and Snow. Both internal and external environment factors of the organization will be considered in the proposed model.

LITERATURE REVIEW

Business strategy is viewed as the integrative actions to achieve corporate goals that takes into consideration of both the influences of internal organizational capabilities and the external environment (Nonaka & Toyama, 2007; Hill & Jones, 2007). Therefore, the differences and diversifications in the scope of business strategies can be accounted for by the complexity and variety of the organizational structure. Miles & Snow (1978) typology of strategy focused on the product-market interrelationship and has received great attention in the management literature over the last two decades. DeSarbo, Di Benedetto, Jedidi, & Song (2006) argued that Miles and Snow typology has been the most enduring and scrutinized strategy classification systems (Kabanoff & Brown, 2008).

Miles and Snow typology classified firms into four archetypes, Defender, Prospector, Analyzer, and Reactor. Defenders are companies that focus on a narrow market in which they attempt to

seal off a part of the total market and to remain competitive through creating a stable set of products and customers. Prospectors are organizations that focus on constant innovations. They seek to exploit new product and market opportunities, and tend to be highly flexible and entrepreneurial. Analyzers occupy an intermediate position that combines certain characteristics of both Prospectors and Defenders. They compete on the Defender's strengths of efficiency, and act like Prospectors to search for innovations. Reactors are firms that exercises incoherent strategy therefore are usually fragile and hard to sustain in business (Ghoshal, 2003). In this research, we demonstrate the effectiveness of our proposed strategy evaluation model using Miles and Snow typology.

The process of formulating business strategies

Previous research in strategy has identified several factors that can affect the relationship between decision process and organizational outcomes. The process of formulating the generic strategies should reflect the interaction between an organization and its environment, hence environment related analysis should be viewed as the basis of the decision and can assist in accomplishing a firm's mission. (Elbanna & Child, 2007; Kabanoff & Brown, 2008). We review the relevant dimensions of the external and the internal environments in the following sections.

External Environment

The dimensions that the firms have to continuously monitor in the external environment in order to make better policy and to attain competitiveness are depicted in Figure 1 (Hill & Jones, 2004; Porter, 1980).

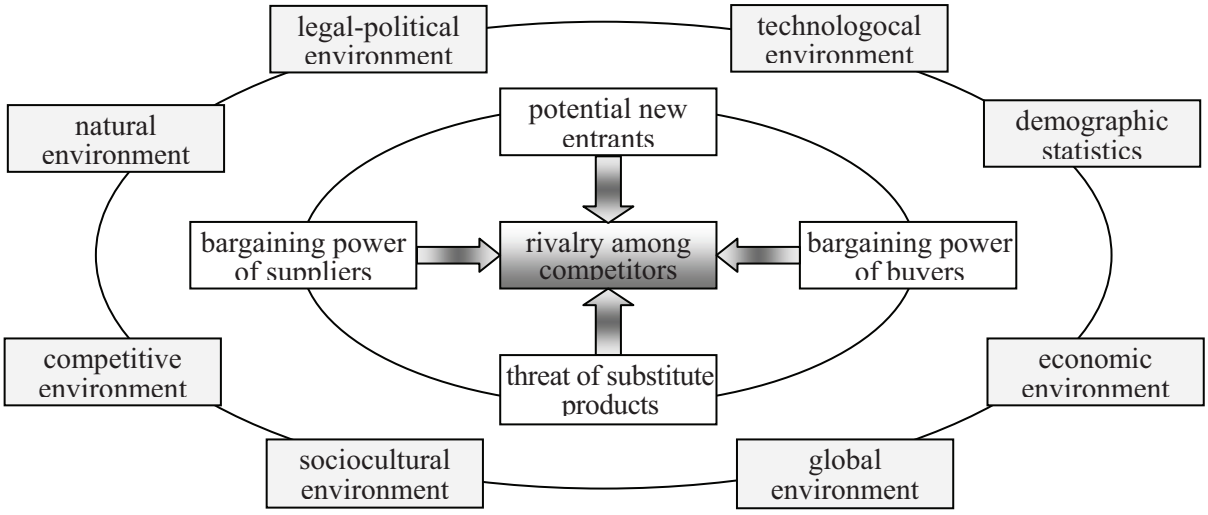


Figure 1 Dimensions of external environment (adapted from Hill & Jones 2004, Porter 1980)

The performance of strategy are influenced by environmental factors such as dynamism, munificence, and complexity (Harris, 2004;Goll & Rasheed, 2005). Dynamism is the degree and unpredictability of environmental changes; environmental munificence is the capability to make the surplus resource evolve; complexity of the environment reflects the heterogeneity in

the range of the organization's activities. The uncertainty which can be expressed by the degree of environmental turbulence makes it difficult for managers to continuously formulate the proper strategy to respond to the minor cues from external environment. There are both potential benefits and pitfalls to carry on business in an uncertain environment (Hutzschenreuter & Kleindienst, 2006; Elbanna & Child, 2007). Since the degree of uncertainty is hard to evaluate, Ansoff (1990) divided the environment into five levels of turbulence according to the difference on its intensity. Table 1 shows the corresponding strategic aggressiveness necessary for success at each turbulence level. For example, the organizations that experience repetitive external environment should maintain stable strategy unless forced by a threat to their survival. On the other hand, companies in expanding environment will succeed if they can be reactive and modify their strategy in response to competitors' actions. The level of turbulence arises, the need for innovation and technology increases. In this research, we adapted and quantified the factors presented in Table 1 in our proposed model to evaluate and rank the appropriateness of the four strategies.

Table 1 Matching of business strategy aggressiveness to the degree of environmental turbulence

Environmental turbulence	Repetitive	Expanding	Changing	Discontinuous	Surprising
Strategic aggressiveness	Stable	Reactive	Anticipatory	Entrepreneurial	Creative
Level	1	2	3	4	5

(source: Ansoff, 1990)

Internal Environment

Many tools and techniques have been introduced and implemented to assay the resources and capabilities of companies and recommend ways to enhance firms' competitiveness. One of the most widely adopted methods both by researchers and practitioners (e.g. Spence & Kale, 2008; Francis, Simons, & Bourlakis, 2008) is the value chain model developed by Porter (1985) as shown in Figure 2. It is implemented as the basis in diagnosing the future needs of resources and capabilities of firms in order to remain competitive.

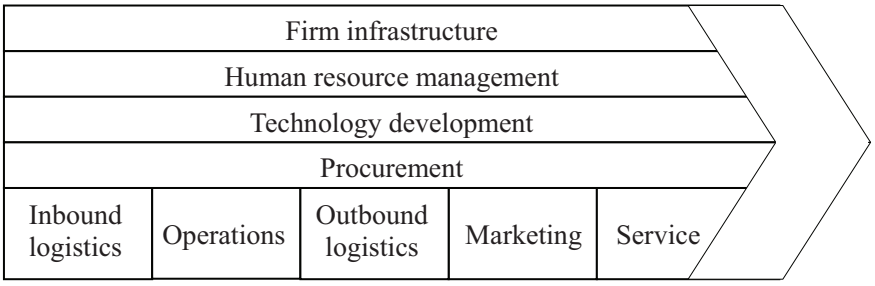


Figure 2 Porter's value chain model (source: Porter, 1985)

When evaluating the competitiveness of firms resources and capabilities in value chain, the VRIO framework (Valuable, Rare, Imitability, and Organization), a resource-based theory by (Barney & Hesterly, 2006), is usually applied. The framework identifies the organization's internal strengths and weaknesses by comparing the resources and capabilities of the firm with that of the competitors along the four dimensions (Sebestova & Wagnerova, 2007; Sebestova, Szkandera, & Bernatik, 2008).

In order to take into consideration of both external and internal environment factors and the uncertainty nature of the environment when evaluating the firms' strategy, we propose a multiple attributes decision support model based on fuzzy membership functions to capture the environment uncertainty. Unlike previous researches in strategic management that are mostly qualitative, this research suggests a quantitative model that allows managers to evaluate and select the right business strategy in a more systematic and scientific fashion.

Fuzzy multiple attributes decision support model

Fussy theory was first developed by Zadeh (1965) to quantify linguistic terms. Fuzzy multiple attribute decision making (FMADM) model combines the concepts of fuzzy theory and multiple attributes decision making theory to solve the problems of multiple attribute decision making that involves uncertainty (Chen, Fung, & Tang, 2006; Xu & Chen, 2007). In this research, we aggregate both external and internal environment attributes using FMADM that allows objective evaluation of all relevant factors together to measure the appropriateness of each strategy.

MODEL BUILDING PROCESS

We first identify all the relevant factors both from external and internal environments through the analysis of literature. Data need to be collected to determine the factor values and factor weights for each factor with corresponding fuzzy operation parameters in order to combine values and weights into fuzzy utility functions (Su, Shi, & Lai, 2008).

Model of external environment analysis

The factors proposed by Porter (1985) and Hax & Majluf (1996) are used to describe the relevant attributes from external environment as shown in Table 2.

Table 2 Summary of the external environment factors and notations

factors	Primary factors	Notations	Secondary factors	Notations
General environment	Technologocal environment	x_1^{OG}	Since general environment covers a wide range, only an integral sketch can be given of the factors herein.	No
	Competitive environment	x_2^{OG}		
	Sociocultural environment	x_3^{OG}		
	demographic statistics environment	x_4^{OG}		
	Global environment	x_5^{OG}		
	Economic environment	x_6^{OG}		
	Natural environment	x_7^{OG}		
	Legal-political environment	x_8^{OG}		
Industry environment	Potential new entrants	x_1^{OI}	Economies of scale	x_{11}^{OI}
			Product differentiation	x_{12}^{OI}
			Brand identification	x_{13}^{OI}
			Switching cost	x_{14}^{OI}

			Access to distribution channels	x_{15}^{OI}
			Capital requirements	x_{16}^{OI}
			Access to latest technology	x_{17}^{OI}
			Industry protection	x_{18}^{OI}
			Industry regulation	x_{19}^{OI}
			Consistency of policies	x_{110}^{OI}
			Capital movements among countries	x_{111}^{OI}
			Custom duties	x_{112}^{OI}
			Foreign exchange	x_{113}^{OI}
	threat of substitute products	x_2^{OI}	Availability of close substitutes	x_{21}^{OI}
			User's switching costs	x_{22}^{OI}
			Substitute price-value	x_{23}^{OI}
	bargaining power of buyers	x_3^{OI}	Number of important buyers	x_{31}^{OI}
			Buyers' threat of backward integration	x_{32}^{OI}
			Contribution to quality of buyers' products	x_{33}^{OI}
	bargaining power of suppliers	x_4^{OI}	Number of important suppliers	x_{41}^{OI}
			Suppliers' threat of forward integration	x_{42}^{OI}
			Contribution to quality of the industry product	x_{43}^{OI}
	rivalry among competitors	x_5^{OI}	Concentration and balance among competitors	x_{51}^{OI}
			Industry growth	x_{52}^{OI}
			Fixed cost	x_{53}^{OI}
			Product differentiation	x_{54}^{OI}
			Corporate strategic stakes	x_{55}^{OI}
			Asset specialization	x_{56}^{OI}
			One-time cost of exit	x_{57}^{OI}
			Strategic interrelationships with other businesses	x_{58}^{OI}
			Emotional barriers	x_{59}^{OI}
			Government and social restrictions	x_{510}^{OI}

The fuzzy membership functions are used to represent the uncertainty of the dynamism, munificence, and complexity of the general environment (Sirmon, Hitt, & Ireland, 2007; Rueda-Manzanares, Aragón-Correa, & Sharma, 2008) and industry attractiveness of the external environment. Table 3 summarizes the external environment characteristics and its corresponding membership functions. The following explains the notations adopted by our model:

f_n The membership functions of the general environment factors (n = 1,2,3,…,8)

y_{um} The membership functions of the industry environment factors ($m = \{13,3,3,3,10\}$) that belongs to each primary factor (u = 1,2,3,4,5)

a Constant of the model that can be determined by users

α The degree of the marginal decreasing effect

β The degree of the marginal increasing effect
k The upper limit of the membership function
x The variables of the model
i The primary factors of internal environment (i =1,2,3,…9)
γ The polar point of S-curve
c The weight of factors
w The weight of factors

The selection of membership functional form is based on the review of literature, and the relationships between performance and capability can be summarized as a nonlinear equation. For instance:

Let x_{Mn}^{OG} denotes the degree of environmental munificence, k_{Mn}^{OG} indicates the upper limit of the impact of the uncertainty, and a_{Mn}^{OG} be a constant that can be set by users according to problem situation. Munificence is one of the factors inducing uncertainty, and as a moderator of the relationship between decision making and organizational performance (Goll & Rasheed, 2005). The munificence of environment supports additional resources to the firm and the level of sustained growth complied with the environmental uncertainty (Chung & Beamish, 2005); moreover, Let f_{Mn}^{OG} indicates the relationship between environmental munificence and uncertainty which is the direct proportion of indefinite marginal effect, and the membership value is always between zero and one. Based on the above analysis, we can obtain the membership function of munificence as follows:

$$f_{Mn}^{OG} = \frac{k_{Mn}^{OG}}{\left(a_{Mn}^{OG}\right)^{\frac{1}{x_{Mn}^{OG}}}}$$

Following the same approach, we are able to derive the other three membership functions of external environment factors as shown in Table 3.

Table 3 Summary of the external environment factors and corresponding membership functions

Characteristics	Membership functions	Descriptions
Dynamism	$f_{Dn}^{OG} = \left(a_{Dn}^{OG}\right)^{\beta_{Dn}^{OG} x_{Dn}^{OG}} - 1$	Oreja-Rodriguez & Yanes-Estevez (2007) show that the relationship between dynamism and environmental uncertainty is direct proportion. Freel (2005) point out the more dynamic environment, the greater environmental uncertainty to bring.
Complexity	$f_{Cn}^{OG} = \left(a_{Cn}^{OG}\right)^{\beta_{Cn}^{OG} x_{Cn}^{OG}} - 1$	Oreja-Rodriguez & Yanes-Estevez (2007) show that the relationship between complexity and environmental uncertainty is direct proportion. A greater degree of complexity exacerbates uncertainty in the institutional environment. (Chung & Beamish, 2005)
Industry attractiveness	$y_{um}^{OI} = 1 - \left(a_{um}^{OI}\right)^{\alpha_{um}^{OI}\left(x_{um}^{OI}-1\right)}$	The increasing threats lead the gap in entering an industry to increase and the industry attractiveness decrease.

Internal environment analysis

The internal environment factors, corresponding factors, and notations are showed in Table 4.

Table 4 Summary of the internal environment factors and notations

Factors	Notations	Secondary factors	Notations	Proposed authors
Inbound logistics	x_1^I	Delivery reliability	x_{11}^I	Boyaci & Ray (2006), Schuh (2006)
		Forecasting accuracy	x_{12}^I	Gunasekaran & Kobu (2007)
operating	x_2^I	Capacity utilization	x_{21}^I	Gajanan & Malhotra (2007), Bansak, Morin, & Starr (2007)
		Defective rate	x_{22}^I	Roberts (2004), , Kwak & Anbari (2006)
Outbound logistics	x_3^I	Delivery reliability	x_{31}^I	Holweg & Miemczyk (2003)
		Damage rate	x_{32}^I	Forslund (2007)
Marketing	x_4^I	Market share	x_{41}^I	Hax & Majluf (1996), O'Sullivan & Abela (2007)
		Price sensitivity	x_{42}^I	
		Channel effect	x_{43}^I	
		Market acceptance	x_{44}^I	
Services	x_5^I	Response time	x_{51}^I	Alexander, Dayal, Dempsey, & Vander Ark (2002), Gaiardelli, et al. (2007)
		Customer satisfaction	x_{52}^I	van Birgelen, de Ruyter, de Jong, & Wetzels (2002)
firm infrastructure	x_6^I	Organizational culture	x_{61}^I	Henri (2006), Glomseth, Gottschalk, & Solli-Sæther (2007)
		Team performance	x_{62}^I	Patrashkova-Volzdoska, McComb, & Green (2003), Hirst & Mann (2004)
Human resource management	x_7^I	Human experiment	x_{71}^I	Sullivan (2000), Welbourne & De Cieri (2001)
		Human skill	x_{72}^I	Wells & Schminke (2001), Chen & Klimoski (2007)
Technology development	x_8^I	R&D intensity	x_{81}^I	Zhang, Lil, Hitt, & Cui (2007)
		Technology maturity	x_{82}^I	Randall, et al. (2004), Schuh & Leviton (2006)
procurement	x_9^I	Supplier performance	x_{91}^I	Modi & Mabert (2007), Ryu & Eyuboglu (2007)
		Order Fulfillment	x_{92}^I	Burke, Carrillo, & Vakharia (2007)

After defining the notations of the internal environmental factors, we can identify the membership functions corresponding to each factor of internal environment as presented in Table 5.

Table 5 The membership functions of internal environment factors

factors	Membership functions	References and their descriptions
Delivery reliability	$y_{V11}^I = \frac{k_{V11}^I}{\left(a_{V11}^I\right)^{\frac{1}{x_{V11}^I}}}$	Sridharan & Li (2008) and Soepenberg, Land, & Gaalman (2008) point out that high delivery reliability is one of the critical criteria for winning performance.
Forecasting accuracy	$y_{V12}^I = \frac{k_{V12}^I}{\left(a_{V12}^I\right)^{\frac{1}{x_{V12}^I}}}$	The higher forecasting accuracy, the higher values of it. (Lawrence, O'Connor, & Edmundson, 2000; Gunasekaran & Kobu, 2007)
Capacity utilization	$y_{V21}^I = \left(a_{V21}^I\right)^{\beta_{V21}^I x_{V21}^I} - 1$	Bansak, et al. (2007) shows that the higher capacity utilization increased manufacturing capacity.Sun (2007) explores that the profits and value-added elements increased at higher capacity utilization levels.

Defective rate	$y_{V22}^{I}=1-\left(a_{V22}^{I}\right)^{\alpha_{V22}^{I}\left(x_{V22}^{I}-1\right)}$	Freimer, Thomas, & Tyworth (2006) discovered that there is a negative relation between the rate of defective goods produced and the organizational performance.
Delivery reliability	$y_{V31}^{I}=\frac{k_{V31}^{I}}{\left(a_{V31}^{I}\right)^{\frac{1}{x_{V31}^{I}}}}$	Sridharan & Li (2008) and Soepenberg, et al. (2008) point out that high delivery reliability is one of the critical criteria for winning performance.
Damage rate	$y_{V32}^{I}=1-\left(a_{V32}^{I}\right)^{\alpha_{V32}^{I}\left(x_{V32}^{I}-1\right)}$	Forslund (2007) emphasized the importance of a low damage rate for customers.
Market share	$y_{V41}^{I}=\frac{k_{V41}^{I}}{\left(a_{V41}^{I}\right)^{\frac{1}{x_{V41}^{I}}}}$	Vorhies & Morgan (2003) used market sharing to represent the products or service sales situation. Baker & Sinkula (2005) used change in market share as an indicator of firm performance, and figured out the performance is positively related in market share.
Price sensitivity	$y_{V42}^{I}=\frac{k_{V42}^{I}}{\left(a_{V42}^{I}\right)^{\frac{1}{x_{V42}^{I}}}}$	Price sensitivity in the grasp of dominate firms always bring the better performance. (Hsieh & Chang, 2004; Wakefield & Inman, 2003)
Channel effect	$y_{V43}^{I}=\frac{k_{V43}^{I}}{\left(a_{V43}^{I}\right)^{\frac{1}{x_{V43}^{I}}}}$	The effective channel minimized the total expected distribution cost. (Alptekinoğlu & Tang, 2005)
Market acceptance	$y_{V44}^{I}=\frac{k_{V44}^{I}}{\left(a_{V44}^{I}\right)^{\frac{1}{x_{V44}^{I}}}}$	The acceptance degree of brand information is getting higher, the customers will be willing to consume. (Hax & Majluf, 1996; O'Sullivan & Abela, 2007)
Response time	$y_{V51}^{I}=\frac{k_{V51}^{I}}{\left(a_{V51}^{I}\right)^{\frac{1}{x_{V51}^{I}}}}$	Mattila & Mount (2003) and Persse, Jarvis, Corpening, & Harris (2004) argued that a faster response has a positive influence on customer evaluations.
Customer satisfaction	$y_{V52}^{I}=\frac{k_{V52}^{I}}{\left(a_{V52}^{I}\right)^{\frac{1}{x_{V52}^{I}}}}$	The degree of solving customers' problem in one time visit is higher, the service performance is better. (Gaiardelli, et al., 2007; van Birgelen, et al., 2002)
Organizational culture	$y_{V61}^{I}=a_{V61}^{I}x_{V61}^{I}$	Organizational culture has a significant impact on the implementation of business activities. (Chan, Shaffer, & Snape, 2004; Stock, McFadden, & Gowen III, 2007)
Team performance	$y_{V62}^{I}=a_{V62}^{I}x_{V62}^{I}$	Garnett, Marlowe, & Pandey (2008) and Kim (2002) found that trusting and effective communication in teamwork is associated with better performance.
Human experiment	$y_{V71}^{I}=\left(a_{\mathrm{V}71}^{I}\right)^{\beta_{V71}^{I}x_{V71}^{I}}-1$	Stavrou, Charalambous, & Spiliotis (2007) explored human resource is a source of organizational performance. Human experiment is positively associated with firm performance. (Bae, Chen, & Wan, 2003)
Human skill	$y_{V72}^{I}=\left(a_{\mathrm{V}72}^{I}\right)^{\beta_{V72}^{I}x_{V72}^{I}}-1$	Human skill has a positive and significant impact on organizational performance. (Liu, Combs, Ketchen, & Ireland, 2007; Conner, 2006)
R&D intensity	$y_{V81}^{I}=\frac{k_{V81}^{I}}{1+e^{-\beta_{V81}^{I}\left(x_{V81}^{I}-\alpha_{V81}^{I}\right)\left(1-\gamma_{V81}^{I}\right)}}$	Kuzents (1930) applied the perspective of S-curve on deriving the technology change model.
Technology maturity	$y_{V82}^{I}=\frac{k_{V82}^{I}}{1+e^{-\beta_{V82}^{I}\left(x_{V82}^{I}-\alpha_{V82}^{I}\right)\left(1-\gamma_{V82}^{I}\right)}}$	Wonglimpiyarat & Yuberk (2005) and Boretos (2007) used the concept of S-curve to evaluate the process of technology development.
Supplier performance	$y_{V91}^{I}=1-\left(a_{V91}^{I}\right)^{-\alpha_{V91}^{I}x_{V91}^{I}}$	Hallikas, Puumalainen, Vesterinen, & Virolainen (2005) and Camuffo, Furlan, & Rettore (2007) found that the supplier performance is better, the purchasing risk will decrease, and the add value will increase.
Order Fulfillment	$y_{V92}^{I}=1-\left(a_{V92}^{I}\right)^{-\alpha_{V92}^{I}x_{V92}^{I}}$	Morgan & Dewhurst (2008) used the order fulfillment rate to evaluate the performance of purchase activities.

Finally, an aggregated viewpoint was taken to describe the membership functions of the VRIO framework, rareness, imitability, and organization, Table 6 shows the references, descriptions, and membership functions of those factors.

Table 6 The other membership functions of internal environment factors

Factors	Membership functions	References and their descriptions
Rareness	$y_{Ri}^{I} = \left(a_{Ri}^{I}\right)^{-\beta_{Ri}^{I} x_{Ri}^{I}}$	Barney & Hesterly (2006) argued that the resource rarity generally had a positive effect on firm's performance. Ainuddin, Beamish, Hulland, & Rouse (2007) proposed the rarity of resource had significant and positive influence on performance for the capabilities.
Imitability	$y_{Ii}^{I} = \left(a_{Ii}^{I}\right)^{-\beta_{Ii}^{I} x_{Ii}^{I}}$	For a capability, firm performance will be positively associated with its imitability. (Ainuddin, et al., 2007; Lavie , 2006)
Organization	$y_{Oi}^{I} = \frac{k_{Oi}^{I}}{\left(a_{Oi}^{I}\right)^{\frac{1}{x_{Oi}^{I}}}}$	Firms' resources become capabilities when they are integrated or organized in the performance of business activities. (Beard & Sumner, 2004; Barney & Hesterly, 2006)

Weight analysis

To determine the values of factor weights and the set of fuzzy numbers, expert opinion or survey questionnaire can be used to find out the importance of each factor. In this research, we used linguistic variables such as "very unimportant," "unimportant," "normal," "important," and "very important" to denote the factors' weight, and used the "core" member of the fuzzy number to represent a linguistic value in the MADM approach (Chen, et al., 2006; Xu & Chen, 2007). For example, the triangular fuzzy number (0.6, 0.8, 1) was used to approximate the linguistic variable "Important" (see Figure 3). Table 7 presents the fuzzy numbers and crisp scales (α-cut) of each linguistic variable.

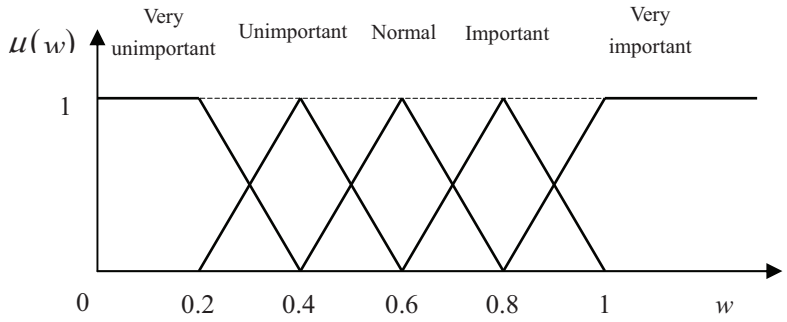


Figure 3 Fuzzy numbers for approximating linguistic weighting values

Table 7 Fuzzy numbers and α-cut of linguistic variables

Linguistic variables	Very important	Important	Normal	Unimportant	Very unimportant
Fuzzy numbers	$\begin{cases} 1 & 1 < w \\ 5w-4 & 0.8 < w \le 1 \\ 0 & \text{otherwise} \end{cases}$	$\begin{cases} 5-5w & 0.8 < w \le 1 \\ 5w-3 & 0.6 < w \le 0.8 \\ 0 & \text{otherwise} \end{cases}$	$\begin{cases} 4-5w & 0.6 < w \le 0.8 \\ 5w-2 & 0.4 < w \le 0.6 \\ 0 & \text{otherwise} \end{cases}$	$\begin{cases} 3-5w & 0.4 < w \le 0.6 \\ 5w-1 & 0.2 < w \le 0.4 \\ 0 & \text{otherwise} \end{cases}$	$\begin{cases} 2-5w & 0.2 < w \le 0.4 \\ 1 & 0 < w \le 0.2 \\ 0 & \text{otherwise} \end{cases}$
α-cut	$\left[\frac{\alpha+4}{5}, 1\right]$	$\left[\frac{\alpha+3}{5}, \frac{5-\alpha}{5}\right]$	$\left[\frac{\alpha+2}{5}, \frac{4-\alpha}{5}\right]$	$\left[\frac{\alpha+1}{5}, \frac{3-\alpha}{5}\right]$	$\left[0, \frac{2-\alpha}{5}\right]$

The aggregated function

The aggregation process includes the following four steps:

Step 1: Aggregate the membership function and the factor weight of each secondary factor.
Step 2: Integrate the membership function and the factor weight of each primary factor, which was composed by secondary factors.
Step 3: Combine the effects of the external and internal factors.
Step 4: Construct the strategy evaluation model

Step one

To aggregate the environmental factors using fuzzy weighted average operator, the results of the external and internal environmental factors are presented in Table 8 (partial results). The following is an example to formulate the membership function of a potential new entrant:

Let c_{1m}^{OI} be the weights of *m* secondary factors of potential new entrants, where m = 13 (see Table 2), and y_{A1}^{OI} denotes the membership function of potential new entrants which consists of thirteen factors. The weighted average is calculated to combine the impacts of all 13 secondary factors into one primary factor, potential new entrants.

By the same token, we can obtain the other integrated functions as shown in Table 8.

Table 8 The membership functions of environmental factors

Factors	Functions
Potential new entrants	$y_{A1}^{OI} = \frac{\sum_{m=1}^{m_1} c_{1m}^{OI}\left(1-\left(a_{1m}^{OI}\right)^{\alpha_{1m}^{OI}\left(x_{1m}^{OI}-1\right)}\right)}{\sum_{m=1}^{m_1=13} c_{1m}^{OI}}$
Inbound logistics	$y_{V1}^{I} = \frac{c_{V11}^{I}\left(\frac{k_{V11}^{I}}{\left(a_{V11}^{I}\right)^{\frac{1}{x_{V11}^{I}}}}\right)+c_{V12}^{I}\left(\frac{k_{V12}^{I}}{\left(a_{V12}^{I}\right)^{\frac{1}{x_{V12}^{I}}}}\right)}{c_{V11}^{I}+c_{V12}^{I}}$

Step two

To aggregate the weights of primary factor, we used the same fuzzy weighted average operator as step one and the results are summarized in Table 9 (partial results).

Table 9 The membership functions of the internal and external environmental factors

Factors	Functions
Environmental uncertainty	$f_{Un}^{OG} = \frac{w_{Dn}^{OG}\left[\left(a_{Dn}^{OG}\right)^{\beta_{Dn}^{OG} x_{Dn}^{OG}}-1\right]+w_{Mn}^{OG}\left[\frac{k_{Mn}^{OG}}{\left(a_{Mn}^{OG}\right)^{\frac{1}{x_{Mn}^{OG}}}}\right]+w_{Cn}^{OG}\left[\left(a_{Cn}^{O}\right)^{\beta_{Cn}^{OG} x_{Cn}^{OG}}-1\right]}{w_{Dn}^{OG}+w_{Mn}^{OG}+w_{Cn}^{OG}}$
Inbound logistics	$f_{1}^{I} = \frac{w_{V1}^{I}\left\{\frac{c_{V11}^{I}\left(\frac{k_{V11}^{I}}{\left(a_{V11}^{I}\right)^{\frac{1}{x_{V11}^{I}}}}\right)+c_{V12}^{I}\left(\frac{k_{V12}^{I}}{\left(a_{V12}^{I}\right)^{\frac{1}{x_{V12}^{I}}}}\right)}{c_{V11}^{I}+c_{V12}^{I}}\right\}+w_{R1}^{I}\left[\left(a_{R1}^{I}\right)^{-\alpha_{R1}^{I}x_{R1}^{I}}\right]+w_{I1}^{I}\left[\left(a_{I1}^{I}\right)^{-\alpha_{I1}^{I}x_{I1}^{I}}\right]+w_{O1}^{I}\left[\frac{k_{O1}^{I}}{\left(a_{O1}^{I}\right)^{\frac{1}{x_{O1}^{I}}}}\right]}{w_{V1}^{I}+w_{R1}^{I}+w_{I1}^{I}+w_{O1}^{I}}$

Step three

This process aggregates the membership functions of external environmental uncertainty and industry attractiveness, and the results are described in Table 10.

Table 10 Influential functions of external environmental uncertainty and industry attractiveness

	Environmental uncertainty	Industry attractiveness
Functions	$f_U^{OG} = \frac{\sum_{n=1}^{8} w_{Un}^{OG} f_{Un}^{OG}}{\sum_{n=1}^{8} w_{Un}^{OG}}$	$f_A^{OI} = \frac{\sum_{u=1}^{5} w_{Au}^{OI} \left[\frac{\sum_{m=1}^{m_u} c_{um}^{OI} \left(1-(a_{um}^{OI})^{\alpha_{um}^{OI}(x_{um}^{OI}-1)}\right)}{\sum_{m=1}^{m_u} c_{um}^{OI}} \right]}{\sum_{u=1}^{5} w_{Au}^{OI}}$

Step four

We construct the strategy evaluation model for Miles and Snow typology that considers both the importance of internal environment factors to strategies and the fitting of the characteristics of external environment factors to strategies. Table 11 summarizes the fit functions of external environment factors for Miles and Snow typology.

Table 11 Fit functions for Miles and Snow typology

Strategies	Fit functions	
Prospectors	$EGS_1 = 0.5^{\lvert \alpha=1 f_U^{OG} - 0.8 \rvert}$	$EIS_1 = 0.5^{\lvert \alpha=1 f_A^{OI} - 0.8 \rvert}$
Analyzers	$EGS_2 = 0.5^{\lvert \alpha=1 f_U^{OG} - 0.6 \rvert}$	$EIS_2 = 0.5^{\lvert \alpha=1 f_A^{OI} - 0.6 \rvert}$
Defenders	$EGS_3 = 0.5^{\lvert \alpha=1 f_U^{OG} - 0.4 \rvert}$	$EIS_3 = 0.5^{\lvert \alpha=1 f_A^{OI} - 0.4 \rvert}$
Reactors	$EGS_4 = 0.5^{\lvert \alpha=1 f_U^{OG} - 0.2 \rvert}$	$EIS_4 = 0.5^{\lvert \alpha=1 f_A^{OI} - 0.2 \rvert}$

EGS The fitting value of environmental uncertainty
EIS The fitting value of industry attractiveness

This research generalizes the studies of relationships between Miles and Snow typology and environmental factors' weights and the results are summarized in Table 12 (O'regan & Ghobadian, 2006; DeSarbo, Di Benedetto, Song, & Sinha, 2005; Brunk, 2003; Hambrick, 2003; Slater & Narver, 1993.)

Table 12 Summary of environmental factors' weights in Mile and Snow typology

Environment	In prospectors	In analyzers	In defenders	In reactors
Internal environment	important	important	very important	unimportant
External environment	very important	important	normal	unimportant
Inbound logistics	normal	important	important	normal
Operating	very important	important	important	important
Outbound logistics	normal	normal	important	normal
Marketing	very important	important	normal	unimportant
Services	important	normal	normal	normal

To combine the fitting results of external environment and the performance of internal environment, we can transform the linguistic terms in Table 12 into the fuzzy numbers in the strategy evaluation model as shown in Table 13.

Table 13 Competitive strategy evaluation model

Strategies	Evaluating model

Prospectors	$f_1=\dfrac{\left[\frac{\alpha+4}{5},1\right]\left(\frac{w_{U1}^{OG}EGS_1+w_{A1}^{OI}EIS_1}{w_{U1}^{OG}+w_{A1}^{OI}}\right)+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]\left(\frac{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_{IL}^l+\left[\frac{\alpha+4}{5},1\right]f_P^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]\cdot f_{OL}^l+\left[\frac{\alpha+4}{5},1\right]f_M^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_S^l}{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+4}{5},1\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+4}{5},1\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]}\right)}{\left[\frac{\alpha+4}{5},1\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]}$
Analyzers	$f_2=\dfrac{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]\left(\frac{w_{U2}^{OG}EGS_2+w_{A2}^{OI}EIS_2}{w_{U2}^{OG}+w_{A2}^{OI}}\right)+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]\left(\frac{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_{IL}^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_P^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_{OL}^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_M^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_S^l}{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]}\right)}{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]}$
Defenders	$f_3=\dfrac{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]\left(\frac{w_{U3}^{OG}EGS_3+w_{A3}^{OI}EIS_3}{w_{U3}^{OG}+w_{A3}^{OI}}\right)+\left[\frac{\alpha+4}{5},1\right]\left(\frac{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_{IL}^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_P^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_{OL}^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_M^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_S^l}{\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]}\right)}{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+4}{5},1\right]}$
Reactors	$f_4=\dfrac{\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]\left(\frac{w_{U4}^{OG}EGS_4+w_{A4}^{OI}EIS_4}{w_{U4}^{OG}+w_{A4}^{OI}}\right)+\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]\left(\frac{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_{IL}^l+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]f_P^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_{OL}^l+\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]f_M^l+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]f_S^l}{\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+3}{5},\frac{5-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]+\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]+\left[\frac{\alpha+2}{5},\frac{4-\alpha}{5}\right]}\right)}{\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]+\left[\frac{\alpha+1}{5},\frac{3-\alpha}{5}\right]}$

CASE ANALYSIS

To validate the applicability of the proposed model, we implemented the model in a strategic planning project to help evaluating the fitness of each of the four strategies in Miles and Snow typology. The following are the detailed implementation tasks for each phase.

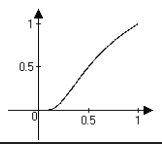
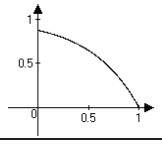
Variables and membership functions formulation

The membership function of each factor is a variable in the strategy evaluation model; therefore the parameter value can be adjusted or revised in accordance with characteristics of the industry and/or enterprise under analysis. It has greatly enhanced the applicability and flexibility of the model to allow proper reflection of the uniqueness of the underlying business environment. To simplify our calculation, we have selected parameter values that are mostly small integer numbers.

External environment

The graphs and ranges of membership functions were affected by the parameter settings, and the results are presented in Table 14.

Table 14 The membership functions of external environmental factors

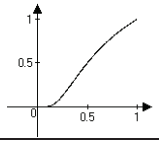
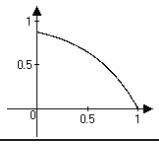
Characteristics	Parameters	Graphs	Membership functions
Munificence	$k_{Mn}^{OG}=2$ $a_{Mn}^{OG}=2$		$f_{Mn}^{OG}=\dfrac{2}{2^{\frac{1}{x_{Mn}^{OG}}}}$
Industry attractiveness	$a_{um}^{OI}=2$ $\alpha_{um}^{OI}=3$		$y_{um}^{OI}=1-2^{3\left(x_{um}^{OI}-1\right)}$

The main objective of the case analysis is to demonstrate the marginal effect of the evaluation. According to our literature review, the external environment factors (Dynamism, Munificence, Industry attractiveness) each belongs to a different membership function therefore has different shape of graph.

Internal environment

Similar procedure is followed to set the parameter values for internal environmental factors. Table 15 shows partial results of the membership functions.

Table 15 The membership functions of internal environmental factors

Characteristics	Parameters	Graphs	Membership functions
Delivery reliability	$k^I_{V11}=2,\ a^I_{V11}=2$		$y^I_{V11}=\frac{2}{\frac{1}{2^{x^I_{V11}}}},\ 0\le x^I_{V11}\le 1$
Defective rate	$a^I_{V22}=2,\ \alpha^I_{V22}=3$		$y^I_{V22}=1-2^{3\left(x^I_{V22}-1\right)},\ 0\le x^I_{V22}\le 1$

Data collection and analysis

The values of the external environmental factors relating to the three external environmental characteristics, dynamism, munificence, and complexity were collected from expert of an aerospace company in Taiwan. Table 16 presents partial results of the weights and values of internal environmental factors.

Table 16 The weights and values of internal environmental factors

Factors	The weight of uncertainty	Dynamism		Munificence		Complexity	
		Weight	Value	Weight	Value	Weight	Value
Technological environment	important	normal	0.7	important	0.7	important	0.8
Competitive environment	important	normal	0.7	very important	0.5	important	0.9
Sociocultural environment	normal	normal	0.5	normal	0.5	unimportant	0.3
demographic statistics environment	normal	important	0.5	unimportant	0.3	unimportant	0.2
Global environment	important	important	0.8	normal	0.3	unimportant	0.3
Economic environment	important	important	0.5	normal	0.2	unimportant	0.3
Natural environment	unimportant	normal	0.3	unimportant	0.1	unimportant	0.3
Legal-political environment	important	important	0.5	normal	0.2	normal	0.5

We then plugged in the numbers to the proposed strategy evaluation model and derived the degree of fitness of each strategy as shown in Table 17.

Table 17 Summary of the strategy evaluation results

α	Prospectors	Analyzers	Defenders	Reactors
0.2	[0.277,1.719]	[0.217,2.062]	[0.157,1.817]	[0.110,3.012]
0.4	[0.322,1.227]	[0.279,1.441]	[0.214,1.273]	[0.168,1.822]
0.6	[0.379,0.909]	[0.357,1.047]	[0.287,0.918]	[0.248,1.167]

0.8	[0.456,0.702]	[0.460,0.782]	[0.381,0.676]	[0.363,0.776]
1	[0.561,0.561]	[0.592,0.592]	[0.504,0.504]	[0.529,0.529]

Result analysis

According to the fuzzy theory, the different α-value (shown in column 1) represents different level of confidence in controlling the environmental uncertainty. The higher the uncertainty is, the lower α value will be. The ranges of the intervals in the outcomes of our strategy evaluation model tend to be large when company has little information to handle the environmental uncertainty. On the other hand, when α is closer to 1, it represents the company has perfect information of the environment, the result range of interval should be very small. Regarding the aerospace company case, we can rank the fitness of the strategy from high to low as Analyzers (0.592), Prospectors (0.561), Reactors (0.529), and Defenders (0.504), the maximal evaluated value is 0.592 (Analyzers), the second one is 0.561 (Prospectors), when $\alpha = 1$. Therefore we can conclude that the company should adopt the Analyzers or Prospectors strategies or even consider the combination strategy.

CONCLUSION

The purpose of this research is to propose a strategy evaluation model that implements quantitative analysis techniques and fuzzy membership functions for business strategy selection. The model can assist firms in making more informed and objective decisions by analyzing the opportunities and threats in external environment together with the strengths and weaknesses in internal environment. It is a comprehensive model that encompasses factors identified from several classic researches in the field of strategy. Other contributions of this research include: the model provides a logical process for strategy analysis; the model applies the concept of fuzzy theory to quantify the factors and create membership functions by considering the influence of the characteristics of Miles and Snow typology; the membership degree of environmental factors can serve as an indicator for evaluating the performance of firm's strategy. With an increase of membership degree, the performance of firm's strategy increases. To reduce the subjective bias of the respondents, we transformed the linguistic terms into numbers and aggregated the weights and value of factors using fuzzy weighted average operator. One limitation of this research is we have only investigated the application of our strategy evaluation model to rank and evaluate the four strategies in Miles and Snow typology, one of the most popular strategy classification schemes. However, there are other strategy classification systems available. In the future we plan to investigate more classification schemes that may consider different sets of factors to broaden the scope and applicability of our model. Another possible future research direction is to automate the strategy evaluation model by implementing it using a Windows based business-programming language such as Visual Basic. The program will allow users to easily set parameter values through a user-friendly interface. It could also allow users to perform what-if analysis by altering some of the parameter settings.

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MARKETING STRATEGY, CHANNEL BRAND EQUITY AND PERFORMANCE: EVIDENCE FROM THE TAIWAN TV SHOPPING CHANNELS

Tsui-Yii Shih*
Department of Business Administration
LungHwa University of Science and Technology
trace@ms16.hinet.net; tsuiyii@mail.lhu.edu.tw
300, Sec. 1, Wanshou Rd., Guishan Shiang, Taoyuan, Taiwan, R.O.C.

ABSTRACT

Take a glace at the Taiwan virtual shopping environment. A growing number of branding manufacturers compete by decreasing product price, improving product quality or enhancing brand image. Numerous non-famous branding suppliers cooperate with famous TV shopping stores to reduce marketing costs and promotion risks, while increasing sales performance. Because consumers do not spend all their time online, they work, listen music, watch TV and read magazines, more and more TV shopping channels design marketing strategy or provide wholly customer post-purchase services, and increase the famous degrees and brand image of channels, to maintain consumer loyalty. Based above discussion, the research examines the marketing mix (e.g. price, advertising and selling international brands, etc) and channel branding issues (e.g. brand awareness, perceived quality, brand image, etc) for TV shopping stores. This paper provides the discussion of marketing strategy and channel brand equity for TV shopping retailers via consumer viewpoints.

By adopting an integrated perspective emphasizing the roles of marketing strategy and brand equity, this paper addresses these key gaps by developing empirical firm-marketing explanations of consumer purchase intentions and channel brand loyalty for related academic research in terms of linear regression method. The objective of this study is to investigate and evaluate the effect of business marketing strategy, brand equity on consumer purchase and brand loyalty and then examine their importance in allowing manufacturers and retailers to develop a competitive position in the commercial marketplace. The findings have the potential to offer significant implications for theory and practice.

Bring varied consumer-level notions of marketing management strategies toward TV shopping channels into the same plane as market-level measures of brand performance such as channel brand loyalty, customer purchase intention. Research findings indicate TV

* Please send all correspondence to Tsui-Yii Shih, Department of Business Administration, LungHwa University of Science and Technology, 300, Sec. 1, WanShou Rd., GuiShan Shiang, Taoyuan County 333, Taiwan, ROC. E-mail: trace@ms16.hinet.net; tsuiyii@gmail.com Tel: +886-2-82093211#6512; Fax: +886-2-82093211#6510.

shopping channels should (1) intensify emotional appeal, reduce rationalized appeal of advertising strategy, (2) sell international brand products in the context of a brand alliance strategy, and (3) develop channel brand equity helpful to the channel brand loyalty and purchase intention of consumers. The research results will help TV shopping retailers to formulate suitable marketing and branding strategies. In addition, the research results could be referenced by the manufacturers to decide their virtual channel marketing strategy. Further, the research findings contribute to the marketing theory and branding research in academia.

Keywords: marketing strategy, brand alliance, brand equity

SOURCES OF VALUE CREATION IN ACQUISITIONS: A STRATEGIC BUSINESS PROCESS REENGINEERING PERSPECTIVE

Dr. Stacy Huey-Pyng Shyu,
Graduate Institute of Business Management,
National Kaohsiung First University of Science and Technology, Taiwan, R.O.C.
stacyshyu@gmail.com

Leon Tsai,
Graduate Institute of Business Management,
National Kaohsiung First University of Science and Technology, Taiwan, R.O.C.

ABSTRACT

Purpose

The strategic thinking behind numerous M&As is: "bigger is more important than better". Such logic is also followed in the growth strategies of many players who believe that increasing scale via M&As will bring sustainable competitive advantage and generate above-average financial performance and value creation for their shareholders. But numerous failed M&As and the modest financial performance of many large players compared to smaller ones question the universality of this logic. The aim of this article is to emphasize strategic business process reengineering perspective to better understand the sources of value creation in acquisitions. Moreover, an integrated approach embraces conceptual viewpoint with resource based view, relational approach, and Porter's five forces are employed as a guideline for managers to formulate projects associated with business process reengineering.

Design/Methodology/Approach

The approach of this paper is to state a comprehensive strategy formulation process guided by three sections: case study to show the importance of operation fit between acquiring firm and acquired firm, business process reengineering initiative, and application of the strategic business process reengineering.

Findings

Scale does not necessarily bring competitive advantage, improve financial performance, or generate scale-related synergies per se. To develop sustainable competitive advantage, executives must understand the true nature and mechanisms which drive the operation fit process, value creation through M&As and the consequent reengineering projects of

enhancing company's competitive advantage.

Originality/Value

The article discloses key strategic elements to be considered when formulating effective corporate strategies in a complex business environment and a context of rapidly mature industries. The discussion also raises awareness regarding the importance of strategic logic, correct interpretation of integrated strategic concepts and guidelines to business practice.

Keywords: Business process reengineering, Merger and acquisition, Competitive advantage, Value creation, Operation fit

INTRODUCTION

Nowadays, a key word in any merger and acquisition (M&As) is "value creation". Value creation can be termed as synergy which delivers synergistic gains such as market power, economies of scale and scope, coinsurance, combination of complementary resources, and risk diversification (Eckbo, 1983; Stillman, 1983; Seth, 1990; Bradley et al., 1988; Malatesta, 1983; Shrieves and Pashley, 1984; Weston et al., 2004). Seth (1990) distinguished alternative sources of gain associated with different acquisition strategies based on capital asset pricing model and discounted cash flow approaches to estimate combined returns of the entity. Seth (1990) further indicated that the related acquisitions with relatively larger size of bidder tended to be associated with an increase in value creation due to operating efficiencies, which are measured by financial or economic ex-post predicator variables. But will this really happen? Why do so many M&As fail to deliver the above-average post-acquisition financial performance, sustain competitive advantages, and gain value creation for their customers, employees, and shareholders?

With failure rate around 50 percent, there was evidence that many mergers and acquisitions had unsatisfactory outcomes (Schoenberg; 2003). Most of the arguments derived from the organizational fit constraints or complexities stemming from the intangible knowledge assets surrounding the integration of people and business process which firms encounter on how to develop new business and products, and redeploying resources rapidly within their boundaries (Capron, 1998; Ranft, 2002; Chatterjee, 2007; Puranam, and Kannan, 2005). That is, there is evidence that ineffective business process integration appears to be a major reason that many acquisitions fail to create value, or from strategic management viewpoint, unable to achieve sustained competitive advantage (Harrison, et al. 1991; Jones and Miskell, 2007). Subsequently, the different value systems between firms can lead to different or opposite arguments with synergistic acquiring firms or acquired firms (Ernst and Vitt, 2000; Ranft and

Lord, 2002). For that reason, organizational value in M&A context, as well as business and technical BPR (Business Process Re-engineering) aligning with strategic fit needed to be taken into accounts. This work aims to show the importance of BRP in M&A through a best-practice company case.

To examine the effect of organizational fit, Daly et al. (2004) investigated M&A effectiveness by examining organizational espoused value. They examined the espoused value in two dimensions: concern for employees and concern for production. Espoused values are those values that are expressed on behalf of the organization or attributed to an organization by its senior managers in public statements such as in the firms' annual reports (Daly et al., 2004). Espoused values differ from what some have termed organizational values, (e.g., Rousseau, 1990), which are shared by all or a large proportion of an organization's members. Daly et al. (2004) found that organizational fit improve the performance of M&As. While Daly et al. (2004) employed statistical analysis of many M&As to show the effect of organizational fit, the current study employs case study to show the importance of operation fit between acquiring firm and acquired firm.

BUSINESS PROCESS RE-ENGINEERING

Business Process Re-engineering Initiatives

Organizations today seek to rationalize, innovate and adapt to changing environments and circumstances as part of business process reengineering (BPR) efforts (Kueng and Kaulek, 1997). As a consequence, many companies are engaged in intensive process redesign for their business processes. Different process models exist for use in analysis, design, and implementation phases (Georgakopoulos et al., 1995; Kueng et al., 1996; Mylopoulos et al., 1999; Ould, 1995; Gans et al., 2003; Gulledge and Deller, 2009). Irrespective of the process reengineering program selected and the IT-related technique used to model it, BPR brings with it the issues of organizational and process changes. Thus, BPR initiatives involve long-term strategic goal for an organization. An integrated strategy map represents a composite potential improvement path of an investigated enterprise, starting from and improvement of its organizational profile towards an improved realization of its business objectives, thus providing strategic map or strategic logic on important linkages between business process management and organizational fit.

Business Process Re-engineering and Strategic M&A Value

As mentioned in prior section, one of the sources of value creation in M&As is scarce complementary resources. Companies can acquire other firms such as a manufacturer of complementary product, or raw material suppliers, in order to control complementary

resources processes. However, the synergies promised to justify the transaction cost show up often as little more than goodwill on the balance sheet, without creating real value for shareholders. As a result, significant, unrealized value remains locked up in mergers. Reengineering is to unlock that value. The entire value chain, the costs of supporting multiple business models and architectures, and the technology road maps required to integrate businesses should be considered for integrating the acquired firm. Understanding the operation fit beyond strategic fit would greatly enhance the probability of successful merger.

Business Process Re-engineering and Integrated Strategy Map

Firms are constantly facing turbulent environmental changes. To remain completive, program, project, IT implementation for re-engineering should involve strategic thinking. Therefore, a conceptual framework encompassing both re-engineering and strategic thinking is required for developing a variety of service-oriented programs and projects across the organizations.

There are some conceptual differences of approaches to be addressed to accomplishing competitive advantage (CA). Three approaches: Porter's five forces (PFA), resources based approach (RBA), and relational approach (RA), pursue similar goals in somewhat different ways, we propose an integrated approach to strengthen the strategic management process in the golf club industry. Advances in understanding the strategic management process toward CA can be impeded if managers adopt the PFA, RBA, or RA one at a time.

Weakness of Non-integrated Strategic Management

During the 1980s, the PFA (Porter, 1980) helped managers understand how they could position their businesses for success in a competitive environment and how industry forces could affect their return on investment. Today, the new business world requires managers to recognize recent developments such as globalization, technological advances, and the Internet as new sources of CA. According to the PFA, firms achieve CA over their suppliers, customers, or competitors. However, this approach does not fully take into consideration advantages of collaborative relationships with suppliers and customers. CA can emerge from the ability of a firm to develop collaborative relationships with more volatile customers (e.g. brand-switching customers) and to manage far-reaching networks of partners for mutual advantage. Furthermore, firms try to form relationships with their competitors to add value to their business.

The RBA has focused on resources that are typically internally developed and that are specific to an organization (Barney, 1991; Wernerfelt, 1984). However, internally developed resources tend not to fully reflect the general needs of market constituents like customers and competitors. Therefore, we need to look at market-based resources such as the firm's market orientation, because those resources enable firms to overcome limitations of functional resources through the "commingling of the organization and the environment" (Srivastava et

al., 1998, p. 3). Market orientation is defined as firm activities/behaviors of offering unique products/services and creating customer value, based on a better understanding of customers' needs and competitors' actions or strategies (Kohli and Jaworski, 1990).

The RA tends to emphasize business-to-business relationships without giving a balanced treatment to business-to-customer relationships that also are important. The business-to-customer relationship is particularly critical in the service industry, because customers pursue ongoing relationships with service providers to reduce their perceived risk in evaluating services (Lovelock, 1983). Because of the intangibility and interpersonal focus of services, customers are likely to form relationships more with organizational members (i.e. employees) than with goods (Gwinner et al., 1998).

An Integrated Approach

Each approach has helped managers understand how CA could be achieved in different ways. However, these approaches have overlooked the fact that:

(1) firm resources are unique among firms within an industry and such unique resources can determine CA (i.e. PFA overlooked);
(2) market-based resources are a critical source of CA (i.e. RBA overlooked); and
(3) firm strategies should be aligned to firm resources (i.e. RA overlooked).

A firm's overall competitive position results from its internal and interfirm resources, both of which are greatly influenced by the firm's external environment (e.g. five industry forces). Because sources of CA tend to be interrelated to one another, an integrated approach will be necessary to obtain and sustain CA. Figure 1 shows how these three approaches are integrated for a comprehensive framework of strategic management. How each approach can contribute to achieving CA has been discussed in previous sections (i.e. A, B, and C in Figure 1).

The success of interfirm relationships can be affected by organizational resources such as organizational culture, decision-making processes, and information sharing among employees (Dyer and Singh, 1998). These organizational resources enable an organization to capture its value created through interfirm linkages. This is shown as "D" in Figure 1. Thus, the RA can be complementary to the RBA in that internal resources can affect the relationship between interfirm resources and firm performance.

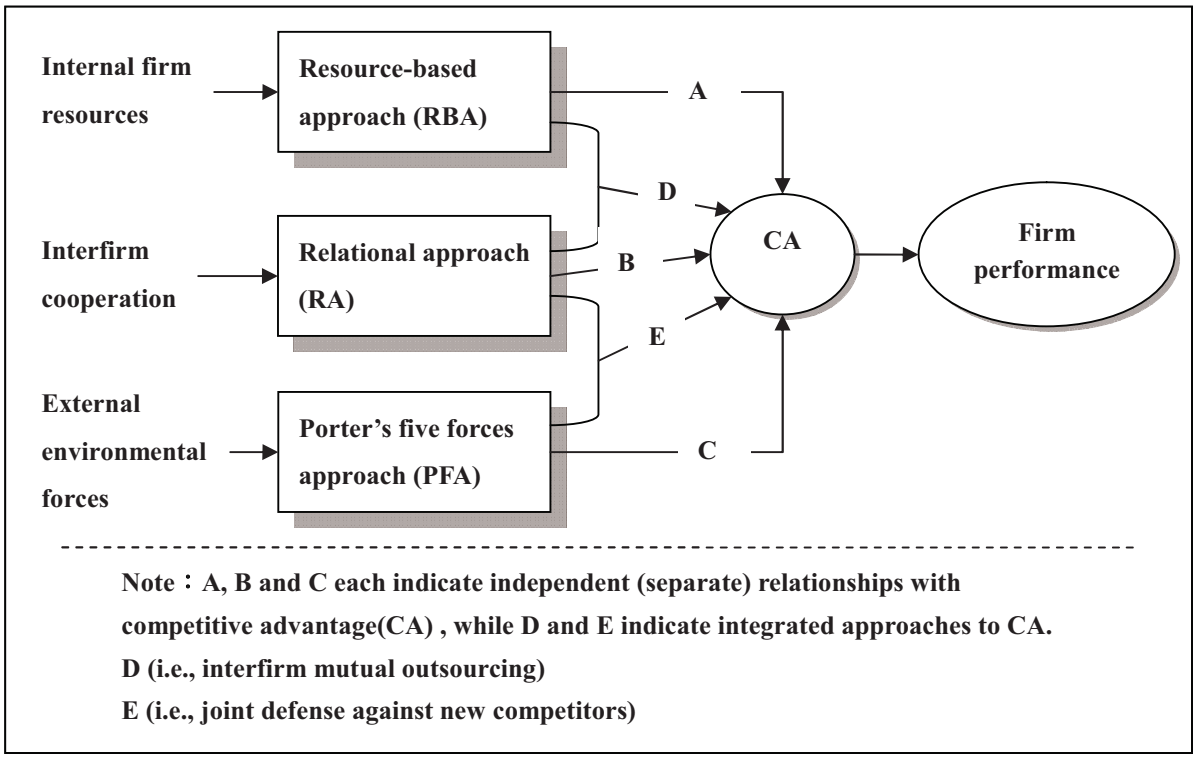

Figure 1. An integrated framework of the three approaches

An integrated approach is helpful in implementing firm strategies more effectively than otherwise. Increased competition encourages a firm to develop interfirm linkages. Competitive intensity described by Porter (1980) forces a firm to provide better products and services than its competitors'. Accordingly, firms should attempt to build close relationships with their suppliers. Cooperative buyer-supplier relationships in the business-to-business context help reduce costs and improve quality to the end buyer (i.e. customers). Reduced purchasing costs and improved product/service quality can enable firms to effectively implement their strategies such as product differentiation or cost leadership (Porter, 1980). Thus, sources of CA for achieving superior performance derived from mutually satisfying, sustainable relationships with suppliers. In addition, it is imperative for firms to build a close relationship with their customers to overcome heavy competition and stay profitable. These situations are described as "E" in Figure 1.

An integrated approach helps companies establish solid footholds for achieving long-term growth and profitability. To achieve long-term growth and profitability, firms should adapt themselves to the rapidly changing industry environment (i.e. PFA), continually develop new resources such as market-based resources (i.e. RBA), and build strong relationships with their customers as well as suppliers (i.e. RA). Because various sources of CA make it

hard for competitors to imitate the sources of CA (that is, value may be created by acquiring scarce complementary resources in M&As), companies can sustain their CA over the competitors.

In addition, an integrated approach would be beneficial to firms in developing an effective strategic plan. Strategic planning determines where a firm is headed in the next few years and how it is going to get there. Therefore, development of a strategic plan helps clarify the firm's future. The success of strategic planning depends on how effectively firm resources can be deployed along key priorities. Thus, identification of various sources of CA can help companies conduct strategic planning and implement the plan effectively.

APPLICATION

Background

With rapid emergency of China and other Southeastern countries, industry structure and markets in Taiwan change dramatically during a short period of time. Many firms shifted their production facilities to China or other Southeastern countries. For manufacturers in the traditional sectors, such as golf club makers, low cost may not be the deciding competitive factor. For example, golf club manufacturers in Taiwan have shortened the replacement cycles of their products and at the same time, they have been able to increase price. This has entailed focusing on golf club heads to make the swing even sweeter. That is a golfing term referring to the most desirable point of impact of the club face to the ball. Club-head components require the highest degree of know-how technical skills, such as CAD file producing, mold making, casting specialized titanium and steel alloys.

To meet the competition from manufacturers located in low cost areas and demands from their OEM customers, manufacturers in Taiwan may use M&As and reengineering to maintain and enhance their competitive advantages. This strategy has been successful so far. The number of golf club heads produced in 2008 by the four largest Taiwanese golf club producers— Advanced International Multitech Co. Ltd. (AIM), Fu Sheng Industrial Co. Ltd., O-TA Precision Industry Co. Ltd., and Dynamic Precision Industry Corp.--totaled about 22.5 million, or nearly 60 percent of total global production.

The Case Company

Advanced International Multitech, (AIM) established in 1987, is a publicly listed Taiwan based company engaged in the manufacturing of golf club heads, shafts, composite materials, carbon fiber components, and accessories for bicycles, such as forks, frames, and seat posts. Headquartered in Kaohsiung, Taiwan, the company employs about 10,500 people.

The golf club industry in Taiwan has been in existence for more than thirty five years. AIM

entered the industry in 1987. Within 20 years, the company has emerged as the largest golf club manufacturers in Taiwan. AIM suppressed other incumbents by focusing on this industry with value creation through acquisitions and integrated strategic business process re-engineering.

The Challenges

The fierce competition in this industry has caused many original equipment manufacturers (OEMs) to focus on their leading product and form partnerships, or purchase other specialized companies, to complete their product portfolio. Some examples from 2000 to 2003 are: Titleist buying Cobra for their low and midline product, Spalding buying Ben Hogan for their top line irons and then Callaway buying Spalding to gain market shares. To meet the demand from their customers, who are brand name owner and are facing intensive competitive pressure, manufacturers in Taiwan are investing enormously in R&D to capture the increased demand for personalized, value-added products, which is a growing portion of the 2.4 billion US$ market for all golf equipment (SRI International, 2002). Since 1990, the number of golfers grew about 5% to about 30 million golfers, hence supporting the demand for personalization. This has largely been explained by the advances in technology which provide customized high-end products highly valued by customers.

Supply Chain Management through Strategic Business Process Reengineering

Gulledge and Deller (2009) distinguished business process management (BPM) between technical IT perspective (Technical BPM) and business perspective associated with competitive advantage enhancement. Therefore, an integrated approach employed to deliver competitive advantage is proposed in this study.

The technical business process management (technical BPM) must be related to value-driven business strategy events to gain interface cost reduction and flexibility. For example, from relational approach perspective, AIM transformed from OEM to original design manufacturer (ODM). Intimate cooperation and coordination within supply chain partners as joint defense against new competitors is demanded, Co-Sports Chain e-project with IT implementation was proposed to reduce inventory cost, to gain competitive advantage in time to end user, time to volume, time to market, and time to technology performance.

Strategic Perspective to Create Business Process Reengineering Value

Companies who own strategic assets (internal firm resources) outperform competitors because they control valuable resources that are hard to replicate. To sustaining competitive advantage in the matured golf club industry (FPA issue encountered), a company should acquire or develop intangible assets such as employee know-how, reputation, and

organizational culture (Michalisin et al., 1997; 2000). To achieve the goal, AIM decomposed their major business operation process (here, operation fit is taken into account) with the following figure 2. which illustrated the process from customer request data input, CAD file producing, tooling, casting, forging, face producing, welding, painting, and shipping. Some of the processes are outsourced prior to M&A activities. Prior to M&As, AIM encountered difficulties in timely satisfying one-stop shopping service for customers. Because big customers quite often requested diversified models and products in one order, AIM had to outsource some of the products such as golf balls. However, golf ball manufacturers quite often couldn't meet the demand on time and the customized materials conforming to different models of shafts. By acquiring a top-tier golf ball manufacturer, AIM would be able to streamline the process and meet the demand of buyers on time as one-stop shopping.

Another merger that AIM did in the past was to purchase two mold manufacturers. Molds are critical technology for golf club manufacturing. Before the merger, the two mold manufacturers were in high demand and again quite often could not meet the deadline requested by AIM. Acquiring the two mold manufacturers involve strategic fit and operation fit. On the strategic facet (RBA issue encountered), due to the scarcity of excellent mold manufacturers, competitors had to look for the second best mold manufacturers, rather than the best.

To achieve effective integration between acquirer and target firm, the senior managers of AIM decided to establish strategic alliance relationship with potential target firms through intangible knowledge assets surrounding the integration of people and process prior the formal acquisition phase. The different value system between firms can lead to greater transfer of tacit knowledge due to increased interaction between individuals in acquired and acquiring firms (Ernst and Vitt, 2000; Ranft et al, 2002). Due to the close cooperation between the members of the two firms and the successful introduction of IT infrastructure, the acquisition started to create values for AIM relative early.

On the operation fit facet, time-lag minimization arises when waiting times between operations are imposed. Since the product design is integral, i.e., the design of most individual components is integral to other components, projects at this stage of the industry's development are best managed by tight integrated operation, which results in shorter delivery time for golf club head. The technology-facilitated forms of interaction or information communication technologies (ICT) also play an important role to strengthen the operation fit during M&A. For example, product knowledge management (PKM) platform facilitates knowledge sharing among various departments. PKM also ensures the quality of the product by enforcing the standard operation procedures. Facilitating the quick search of product information and offering online meetings, PKM shortens the new product development cycles. Thus, ICT strengths the operation fit for M&As.

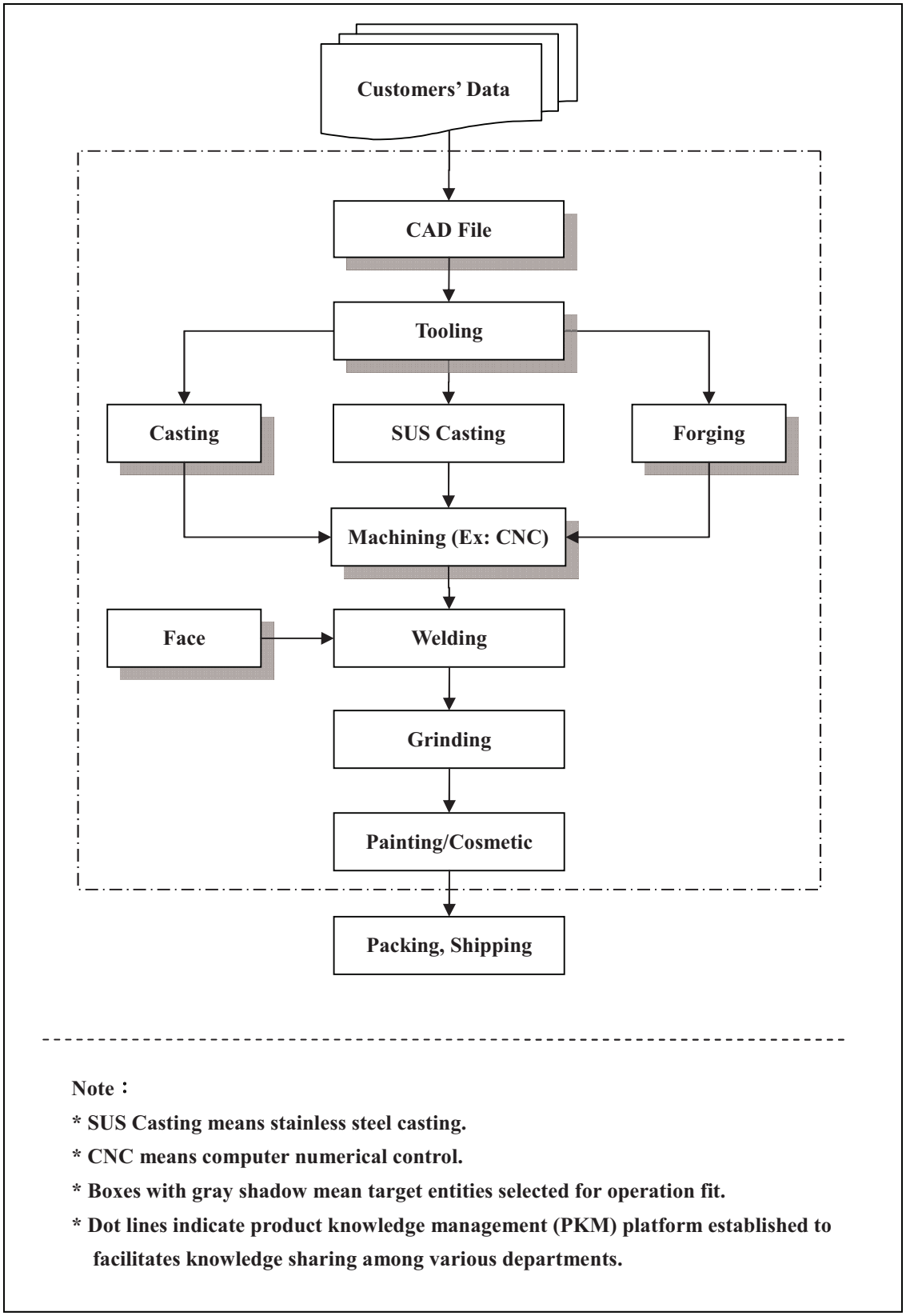

Figure 2. Decomposition of major business operation process in AIM

CONCLUSIONS

While sources of value creation in acquisitions was recognized as an important issue in B2B management literature, the selection of an ideal relationship with target firms would be a major advantage to acquiring firm and a way to achieve competitive advantage. This justifies the need for better understanding in operation fit through examination organizational value in M&A context, as well as business and technical BPR (Business Process Re-engineering) aligning with strategic fit.

Business process reengineering (BPR) involves relatively complex different business process types (Goldkuhl and Lind, 2008) and without the support of Information and Communication Technology (ICT), it would not be accomplished easily (Gulledge and Greg, 2009). This study proposed BPR associated e-project (ex. Co-sports OEM-ODM logistics e-project) stemming from the strategic integrated approach. The integrated approach includes resource base view point, relational approach, and Porter's five force approach to balance a portfolio of competitive advantage stemming from business process reengineering opportunities, that is , a strategic business process reengineering perspective. Successful merger & acquisition (M&A) practice, therefore, requires operation fit in consideration of composite strategic BPR perspective to create organizational value.

The major implication for academicians lies in that the particular connection of strategic logic and BPR implementation for commonly determining M&A for managers is unique in literature. Moreover, this study contributes not only in developing a well-defined integrated strategic process for BPR managers' requirement determination but also determining useful techniques to effectively implement it. In conclusion, a strategy-based analysis is important because firms are able to adopt various internal resources with interfirm cooperation to defend against new competitors.

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MARKETING STRATEGY COMPARISON BETWEEN INTERNATIONAL BRAND AND THAI BRAND FOR PREMIUM COFFEE BUSINESS UNDER CUSTOMERS' PERSPECTIVE: CASE STUDY IN CHIANG MAI, THAILAND

Miss Chulaluck Pratip Na Thalang, School of Management, Mae Fah Luang University, Thailand
ohyoyo_8@hotmail.com

ABSTRACT

Coffee is a main drink for Thai people who love to drink for a long time and less of them are deny it. Because of coffee has it own tasty, sweet and richly scented for drinkers who admire. It makes the Thai and foreign investors are interested to investment due to they look at the chance that will be turn back a lot of benefit in this business. So, this business has more opportunities to grow up but market competitions have more increase. The entrepreneurs should be adapt the strategies both attraction and acceptation in order to follow up the market situations.

The purposes of this study are to compare the marketing strategies for coffee business between International brand and Thai brand under customers' perspective and provide the recommendations to interested investors for doing coffee business in Thailand. The results of the study found that, marketing strategy was not the same for international coffee brand and Thai coffee brand. Due to the most important marketing strategy for Thai coffee brand was product strategy while the most important marketing strategy for international coffee brand was promotion strategy.

The finding this study leads to recommend for impact in short term that have high price elasticity for products, find the outsourcing to reduce the cost of production, reducing the price to lower than competitors, and improve the service to become faster will help to increasing sales. Further more, quality of product, research and development of new technology, have various channels of distributions, decoration for more quality of the coffee shop, product tasting, and build up good relationship between consumers and the brands will be good thing in long term for this business.

Keywords: coffee business, Thai brand, international brand, marketing strategy

INTRODUCTION

Coffee is a main drink for Thai people who love to drink for a long time and less of them are deny it. Because of coffee has it own tasty, sweet and richly scented for drinkers who admire. Today, coffee is still more popular when coffee markets are remodel the product packages for responsible to customer's need in their daily life. Coffee ready-made, coffee can, and premium coffee shop that make the Thai and foreign investors are interested to investment due to they look at the chance that will be turn back a lot of benefit in this business. Until now, more producers are responsible and completely produce. The alternative of various tastes and unique for each brand that effect to the old producers who create the strategies reaching for market share.

Premium coffee shops are more completely, especially the distribution that most are open for modern trade: malls, hyper markets, and discount stores, which force the golden location. So the cost for each branches are high and entrepreneurs could adapt the strategies by

concentrate with vary and difference. To branch up for cover the customer target area by presentation about modern trade such as gas stations, theatres, electric trains, fairs, book stores, hospitals, fitness, electric train stations, and airports.

However the foreign investors in Thailand that shows this business has a lot of promise and carries the opportunities. Thai premium coffee shops are blend to foreign branches and Thai has just 3 premium coffee shops in Singapore, Malaysia, and Indonesia (Kasikorn Research Center, 2005).

The Bubble Economy, since 1997 that premium coffee shops were well-known for investors and consumers in this business type. The factor that supports for business grown up was increase cost together with consumer behavior. They prompted to pay more for quality. Other side, consumers who though about the inexpensive for real coffee with 80-100 baht for each one. Kasikorn Research Center (2005) expects the total value of market with this business is 3,500 million baht. Grown-up rate was still 20 percent per year. Consumers who use the product and service have more variety. Moreover, coffee shops in Thailand are more interested because of Thai consumers. So, the opportunities to run this business were high including with the consumer behavior that drinks for their daily life.

Premium coffee shops have 2 types; foreign premium coffee such as Star's Bucks, Au Bon Pain, Gloria Jeans, UCC and Thai premium coffee such as Black Canyon, Baan Rai Coffee, Coffee World, Modern Coffee. Market shares: inter brand is 60 percent and local brand is 40 percent (Siam Commercial Bank Library, 2003).

Conclusion, the coffee production is the interested business because of the growth up of Thai drinker who still in gain, less than 0.5 kilogram per person and per year or 130-150 cups per year. To expectation, Thai people will consume coffee only 30 percent of Thai population. So, this business has more opportunities to grow up but market competitions have more increase. The entrepreneurs should be adapt the strategies both attraction and acceptation in order to follow up the market situations. (Kasikorn Research Center, 2005).

The objectives of this study

The objectives of this study are to compare the marketing strategies for coffee business between International brand and Thai brand under customers' perspective and in order to provide the recommendations to interested investors for doing coffee business in Thailand.

LITERATURE REVIEW

Pao-Long Chang and Ming-Hua Chieng (2006) to study building consumer-brand relationship: a cross-cultural experiential view. This research aims to develop a framework of consumer-brand relationship by taking an experiential view. In this article, the authors report a cross-cultural comparative study that was conducted on a sample of real consumers at coffee chain stores in Shanghai, China, and Taipei, Taiwan. The findings reveal that individual as well as shared experiences work through brand association, brand personality, brand attitude, and brand image to shape a consumer-brand relationship.

Patrick De Pelsmacker, Wim Janssens, Ellen Sterckx, and Caroline Mielants (2005) to study consumer preferences for the marketing of ethically labelled coffee. The consumers attach greatest importance to the distribution strategy of ethically labeled coffee, followed by the

type of ethical label, and the issuer of the label. Ethically labeled coffee should be available in ordinary supermarkets and be presented along with non-ethical coffee brands. Fair trade labeled coffee is by far the most preferred over eco- and bio-labels. European government labels, or labels issued by non-governmental organizations, are preferred over national (Belgian) government endorsed labels. Consumers prefer extra information on the package, in addition to a label. Out-of-shop promotion of the label and the type of brand are of minor importance. The results are similar across different socio-demographic groups.

Laetitia Radder and Wei Huang (2008) to study high-involvement and low-involvement products: a comparison of brand awareness among students at a South African university. The results indicated a higher awareness of high-involvement product brands than of low-involvement product brands. Advertising played an important role in the awareness of sportswear clothing brands, but seemed unimportant in the case of coffee. The brand name was important for coffee, while the name and the logo played a role in students' awareness of sportswear brands. This study was limited to students of the Nelson Mandela Metropolitan University (NMMU) in Port Elizabeth, South Africa and to sportswear clothing and coffee product categories. Future studies could comprise larger samples, different contexts and other product or service categories. The findings suggest that marketers employ different strategies to create and increase brand awareness for high- and low-involvement products. Previous research found that brand awareness played an important role in low-involvement products; however, little is known about brand awareness differences between high- and low-involvement products, particularly with respect to the brand awareness of South African students.

Janet Adamy (2006) to study different brew: eyeing a billion tea drinkers, star bucks pours it on in China; its big challenge: creating a new taste for coffee, and charging top prices; wooing the 'Little Emperors'. The coffee giant is pursuing the second approach. It's trying to draw in Chinese customers with a new type of informal gathering place. Once captive, that's when consumers' coffee education begins. The chain stacks cream and sugar counters with brochures titled "Coffee Brewing Wisdom" and others that answer questions like "What is espresso?" Workers float through stores passing out small cups of pumpkin-spice latte and other drinks. Good-for-you messages about coffee are sometimes part of the pitch.

Competitors consider the coffee focus a weakness given traditional Chinese tastes. "They will enjoy tea more than coffee," says Garvin Lau, a general manager for Real Brewed Tea. Launched in Hong Kong, the chain of teahouses aims to be "the Starbucks of tea," Mr. Lau says. It has carefully studied the Seattle chain. Real Brewed Tea's 100 or so stylish locations have high ceilings, bright green chairs and menus that tell customers the chain are "determined to become a lifestyle." The stores sell basic tea drinks for about $1.75, slightly less than what Starbucks charges.

Executives didn't think the coffee part stood in their way. They hoped the appeal of the brand and experience of sitting inside Starbucks would be enough to draw Chinese fans. Many of Star buck’s espresso drinks are so heavily sweetened they don't taste like coffee, and some Frappuccinos don't contain any coffee. In 1999, Starbucks opened its first China store in Beijing's China World Trade Center.

Thampaphon Sirisophar (2005) to study attitude and behavior toward fresh coffee consumption star bucks store in Bangkok. The findings of products factors were that aroma scent of crush coffee seeds stirring with hot water and taste were the most important product

attributes. Coffee seeds were needed to grow locally, substituting imported seeds. Pricing was affordable. Service was accelerating. Distribution channels needed to be expanded to cover increasing demands for fresh coffee, or losing to substitute brands. Coupon was a necessary promotion tool which Starbucks neglected. Inferential statistics for data analysation were Pearson Correlation. Hypothesis toward value and benefits of product attributes was null. On the contrary, it was perceived as health hazards because of caffeine. Consumption in store was preferred.

Charles W. Lamb, Jr., Joseph F. Hair, Jr., and Carl McDaniel (2000: 44) say that the term marketing mix refers to a unique blend of product, distribution, promotion, and pricing strategies designed to produce mutually satisfying exchanges with a target market. Distribution is sometimes referred to as place, thus giving us the four Ps of the marketing mix: product, place, promotion, and price. The marketing manager can control each component of the marketing mix, but the strategies for all four components must be blended to achieve optimal results (O.C. Ferrell and Michael D. Hartline, 2005). Any marketing mix is only as good as its weakest component. The best promotion and the lowest price cannot save a poor product. Similarly, excellent product with poor distribution, pricing, or promotion will likely fail.

Variations in marketing mixes do not occur by chance. Astute marketing managers devise marketing strategies to gain advantages over competitors and best serve the needs and wants of a particular target market segment. By manipulating elements of the marketing mix, marketing managers can fine tune the customer offering and achieve competitive success.

Product strategies, a product is anything that is potentially valued by a target market for the benefits or satisfactions it provides, including objects, services, organizations, places, people, and ideas (David W. Cravens, 1997: 292). The product includes not only the physical unit but also its package, warranty, after sale service, brand name, company image, value, and many other factors (Charles W. Lamb, Jr., Joseph F. Hair, Jr., and Carl McDaniel, 2000: 44). It might arguably be said that the product or service that the organization offers for sale is the very reason for its existence. Without a product there is no company.

Distribution (Place) strategies, Ray Wright (1999: 132) say that place of purchase is where and how the product is made available for sale will also reflect on the image of the product and so should compliment all the other elements of the product. Premium priced, quality lingerie would create a negative customer reaction if sold from a stall in the market. Distribution strategies are concerned with making products available when and where customers want them. The goal of distribution is to make sure products arrive in usable condition at designated places when needed (Charles W. Lamb, Jr., Joseph F. Hair, Jr., and Carl McDaniel, 2000: 44). Decisions that are made include the type of channel organizations to use the extent of channel management performed by the firm, and the intensity of distribution appropriate for the product or service. The choice of distribution channels influences buyers' positioning of the brand (David W. Cravens, 1997: 19). Other meaning, distribution having the product available where target customers can busy it, is essential to success. Only in rare cases will customers go to much trouble to secure a particular brand (Del I. Hawkins, David L. Mothersbaugh, and Roger J. Best, 2007: 21).

Promotion strategies, Promotion includes personal selling, advertising, sale promotion, and public relations (Ray Wright, 1999: 144; David W. Cravens, 1997: 20). These activities make

up the promotion strategy, which performs an essential role in positioning products in the eyes and minds of buyers. Promotion's role in the marketing mix is to bring about mutually satisfying exchanges with target markets by informing, educating, persuading, and reminding them of the benefits of an organization or a product.

Pricing strategies, Price is the amount of money one must pay to obtain the right to use the product (Del I. Hawkins, David L. Mothersbaugh, and Roger J. Best, 2007: 21). It is often the most flexible of the four marketing mix elements the quickest element to change. Price is an important competitive weapon and very important to the organization because price multiplied by the number of units sold equals total revenue for the firm (Charles W. Lamb, Jr., Joseph F. Hair, Jr., and Carl McDaniel, 2000: 44). Price strategy involves choosing the role of price in the positioning strategy, including the desired positioning of the product or brand as well as the margins necessary to satisfy and motivate distribution channel participants.

EQUIPMENT AND METHODOLOGY

The questionnaire survey was asked to the consumers who buy coffee both of international brand and Thai brand in Muang Chiang Mai, Thailand 400 persons by random. Then analyzed the data by using SPSS program for windows and described about general information of consumer from frequency and percentage. Second, described about consumer behavior for decision making to buy coffee from frequency and percentage. Third, described about marketing strategies that effect for decision making of consumer from mean and standard deviation. For the third part, it was the rating scale by has ruled to give the counter to 5 levels where score of "5" mean "very important" while score of "1" means "very unimportant". Forth, hypothesis test analyze data with independent-sample t-test and one way anova.

CONCLUSION AND DISCUSSION

Summarize about general information of consumer found that consumers who prefer Thai coffee brand which accounted for 206 people and the consumers who prefer international coffee brand which accounted for 194 people. Most of the sample groups who prefer Thai brand are females accounted for 123 people or 59.7 percent and 76 people or 36.9 percent are between 36-45 years of age. Most of them are working as employees or freelance accounted for 67 people or 32.5 percent and 115 people or 55.8 percent has the income ranges below 10,000 THB per month. Consumers of local brands coffee have highest qualification at bachelor degree which accounted for 104 people or 50.5 percent.

Most of the sample group that choose to consume international brand are male which accounted for 99 people or 51 percent and 100 people or 51.6 percent aged between 16-25 years old. 92 people or 47.4 percent is high school /college students and have income below 10,000 THB per month at 75.3 percent. 98 people or 50.5 percent have highest education at bachelor degree.

For the result about consumer behavior for decision making to buy coffee found that Majority of the consumer of Thai brand drink coffee everyday which accounted for 105 people or 51 percent. 74 people of the people surveyed or 46.5 percent drink coffee in the morning. 57 people or 27.7 percent indicate that Black Canyon Coffee is their favorite brand and 128 people or 62.1 percent like cappuccinos and 82 people or 18.8 percent like the taste of coffee.

81 people or 39.3 percent state that the price of the coffee that they prefer to pay for is below 30 THB per unit. 95 people or 22 percent tend to buy coffee at tourist attractions. 131 people or 63.6 percent state that they prefer the coffee shop that has air condition and 146 people or 66.7 percent of people surveyed state that friends have influence on their decisions about the coffee shop they choose. 159 people or 71.3 percent state that the additional service that they want from the coffee shop is internet. Majority of the consumers (132 people or 43.1 percent) know the coffee shops from promotional activities at the selling points.

Additionally, most of the consumers of international brand drink coffee everyday 75 people or 38.7 percent. 70 people or 39.3 percent tend to drink coffee in the mornings. 24 people or 12.4 percents state that they tend to buy coffee from the brand Coffee World. 115 people or 59.3 percent like to drink cappuccinos. 70 people or 17.8 percent state that they tend to drink coffee because they like the taste of it. 75 people or 38.7 percent state that the price range that they would buy for coffee is 30-39 THB per unit. 92 people or 24.1 percent buy coffee at tourist attractions and 129 people or 66.5 percent like to buy coffee from the shop that has air conditions. 124 people or 62.6% state that friends have influence on their decisions of choosing the shop. 138 people or 75.8 percent say they would like the coffee shop to have internet provide for customers. Additionally, majority of the consumers know the coffee shop from promotional activities at the selling points that accounted for 103 people or 39.5 percent.

The result about marketing strategies that effect for decision making of consumer that summarize into 2 ways that are marketing strategy for Thai brand and marketing strategy for International brand. For Thai brand, they are put in order of the level of importance accordingly; product factors, aroma, this factor has a high level of importance with a total average of 3.79. Distribution channels have a medium importance with a total average of 3.28 which wide distribution of franchises is the highest ranked factor. Also, pricing factors have a medium importance with a total average of 3.22 and the factor that consumer gave most importance to is right pricing. Marketing promotions have a medium importance with a total average of 2.87 and the most important factor that consumers gave importance to is environmental concerns.

For international brands, they are put in order of the level of importance accordingly; marketing promotions have a medium importance with a total average of 2.72 and the most important factor that consumers gave importance to is environmental concerns. Pricing factors have a medium importance with a total average of 2.58 and the factor that consumer gave most importance to is right pricing. Distribution channels have a low importance with a total average of 2.45 which wide distribution of franchises is the highest ranked factor. Also, product factors have a low level of importance with a total average of 2.32 and the factor that consumer gave most importance to choice of own mix.

The results about hypothesis test for comparative marketing mixes that effect on the consumption found that the consumers give importance to the 4 factors namely; products, price, distribution channels and promotions. As for product factors, the consumer give importance to 10 factors namely; aroma, choice of various flavors, special in-house formula, variety of latte arts, brand popularity, container design, product cleanliness, choice of other food and drinks, choice of own mix and state of the art brewing machine and technique. For the factors on price, consumer give importance to 3 different factors namely; right pricing, variety of pricing, and the effect that pricing has on consumer behavior. For the factors on distribution channels, consumer give importance to 8 different factors namely; right location,

wide distribution of franchises, convenient parking space, comfortable seating, shop cleanliness, good interior design, proximity to workplace/ home and polite employees. Lastly, for the factors of promotions, consumers give importance to 4 different factors namely; advertisements, promotional programs, fast service and product tasting.

Other wise, hypothesis test for comparison the different between consumer behavior and personal factors found that consumer behavior related to sex can be classified into 5 issues which are preferred consumption time, preferred store, reason for consumption, price per cup and the concept or preferred shop layout. The factor that related to age can be classified in 5 issues namely; frequency of consumption, preferred store, preferred coffee flavor, price per cup, and preferred shop layout. The factors that related to occupation that make the difference consumption can be classified into 5 factors which are, frequency of consumption, preferred store, preferred coffee flavor, price per cup, and preferred shop layout. The factors that related to income that make the difference consumption can be classified into 5 factors which are, frequency of consumption, preferred store, preferred coffee flavor, preferred shop layout, and people who have influenced choice. The factors that related to education can be classified into 3 issues which are frequency of consumption, price per cup and preferred shop layout.

RECOMMENDATIONS

For use the outcomes of study about "Marketing Strategy Comparison between International Brand and Thai Brand for Premium Coffee Business Under Customers' Perspective: Case Study in Chiang Mai, Thailand" to make marketing strategies planning for efficiency and to be able respond the customer need to get the most satisfaction. In order to add ability for competition and for survive of business, a few recommendations for better and development of coffee business both of Thai brand and International brand are attempted:

Product strategy: The production methods have to concern more on quality of the products and the ingredients have to be clean and safe to consume to prevent any harm to consumers health and any side effects. The invention on new recipe and the practice of the making of latte arts are also important as to attract new customers. Also, research and development of new technology needs to be used to make the best of the products.

Price strategy: The entrepreneurs have to have high price elasticity for their products as to have the flexibility to adjust the price and make it consistence with the market price. Outsourcing is another way to reduce the cost of the production compared to other players in the market. Also, by reducing the price to lower than competitors helps increasing sales.

Place strategy: Because the consumers who choose Thai brands give the importance on number of branches that the coffee shop can provide, so the entrepreneurs should have various channel of distributions in order to get to more consumers, easy access for the consumers and also help increasing the selling number. Furthermore, the cleanliness of the coffee shops, comfortable seats for the consumers and the decoration of the coffee shop are the parts that Thai brands should improve the quality in order to attract more consumers and also help to create a fair competing with the international brands.

Promotion strategy: As the consumer of Thai brands rates the fast of services at medium state, so the entrepreneurs should improve their service to become faster in order to get larger number of consumers and also to increase the satisfaction of the consumers on Thai brands. For the consumers of international brands, the important of product tasting is at medium rate

therefore this type of service should be added to create an opportunity to show the value of our products, indirect advertisements and also build up good relationship between consumers and the brands which can lead frequent consumption of customers. Then the customer would change to be loyalty customers and they will then advice others to try the products. These are what the entrepreneurs should do for the survival of the business.

Moreover, the entrepreneurs both of Thai coffee brand and International coffee brand should study on the satisfactions of the consumer every 6 months in order to understand consumer needs because the consumer behavior can change all the time according to economic situation, social situations or politics. So the entrepreneurs should improve, adjust and carry on the policy in order to satisfy the consumer needs in every way. And also add more topics that were not included in this research or the comparison between others entrepreneurs within the same field in order to adjust the strategies for future management.

This research is completed by using the information from the surveys, which leads to limitations of this research. For better results in the next research both surveys and interviews should be used in order to create a better information interpretation and analysis, and the survey part should provided clear explanations and also people who complete the surveys can only give one answer to each question.

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THE POWER OF EMPLOYER'S BRAND

Dagmara Lewicka, PhD, AGH University of Science and Technology
dagal@poczta.fm

ABSTRACT

The paper focuses on import ant issues connected with shaping employer brands. It lists factors decisive for attractiveness of a brand in the respondents' perception. It analyses factors which make employees loyal to their current employers. Research on which the paper is based is comparative and includes an analysis of preferences demonstrated by potential employees, students and employees of Polish enterprises.

Keywords: employer's brand, labor market, employment decisions, job satisfaction

INTRODUCTION

Even nowadays, contrary to popular belief, enterprises suffer from shortage of talented employees. Research has shown that the trend is going to intensify in time. The question how to enhance attractiveness of employment, attract and keep the best people is continuously growing in importance (Ewing et al.2002). At present, talented staff is as demanding as clients are. In consequence, companies have to fight and care for their staff as they do for their clients. Traditional human resources management was stressing the importance of the organisational culture, mission and value of a company as the main axes which supported the feeling of ownership as well as motivation of employees. As permanent employment contracts have become scarce, it is necessary to find new human capital management tools to ensure staff loyalty. According to the concept of personal marketing, employer's transaction with his employee has turned into an exchange, when in exchange for his initiative, ideas, creation of customer value and multiplication of company's profits, the employee receives an attractive package of working conditions and development opportunities (such as participation in interesting projects, participation in decision making process, working in teams of outstanding experts). Similarly, in the process of employer selection, a talented employee seeks to be hired by a company which offers the best package of opportunities. Among long-term solutions responding to these challenges, actions taken in order to create employer's brand should be mentioned. Activities in the area of building the employer's image have been growing in importance slowly as a field of HR departments' activities in Poland. It was not long ago that organisations with their own plans of building employer's brands, who worked towards their achievement, were in minority. Typically, these were the same organisations who took HR management seriously, as they consider employer branding a part of their selection strategy. It is common knowledge that clients cannot be attached to a brand on the basis of one-off, even very spectacular actions and campaigns. To achieve it, well-planned and long-term activities as well as some financial investment is required.

The strategy of building the image of a good employer requires yet another very import ant element which is cohesion of actions. The key part of the strategy focused on building a desired employer brand is the company's policy towards employees coherent with the assumptions underlying the image as well as activities oriented towards employee development and increase of their job satisfaction. Employees are one of the main carriers of information about a company as an employer. They represent a credible and important source of information for the company's surroundings. Messages conveyed in information

campaigns, which contradicts the status quo can even undermine the company's credibility and have an adverse effect on its image. We may even risk a statement that our culture has become the culture of brands. In particular, the statement applies to young people who tend to appreciate more the brand of a mobile than its technical parameters. Young and talented graduates know that a brand of a good employer in their CV is often a guarantee of their subsequent professional success. The above is confirmed by results of research carried out by the Polish Personnel Management Association and the Warsaw School of Economics (2008) on a sample of 342 large Polish enterprises which demonstrate that, according to 93% of respondents, the image of a company as a good employer is decisive for the efficiency of recruitment processes. 76% of analysed enterprises plan to prepare or revise their employer branding strategies in the coming year.

The paper focuses on employer branding aspects at the HRM level where it is particularly important to ensure employees' loyalty and attachment to employers as well as employee satisfaction from work and feeling of ownership in their organisations. The main contribution of this paper is determination of the importance that various aspects of brand attractiveness have for attractiveness of an employer on the basis of empirical research and analyses. The paper points to differences between factors in the perception of respondents: students and employees, also in terms of their demographic features, gender and years of employment. In addition, the research is an attempt to gain some additional knowledge on factors decisive for perception of an employer brand from the perspective of a member of an organisation. Loyalty understood as an inclination towards (conviction about) the choice of the employer made is analysed as well as taking or not taking own employer in consideration as a possible option upon subsequent choice of employer in relation to various factors shaping the perception of employer brand.

THE CONCEPT OF EMPLOYER'S BRAND

Employer brand in the meaning of building the employer's brand is one of possible answers to challenges of the ever-changing labour market, where the importance of employees' position is growing. As regards employer brand it is assumed that a brand of an organisation as an employer can be built in the same way as brands addressed to clients are built. The concept of employer's brand is a package of functional, economic and psychological benefits from employment, which are linked to a given organisation i.e. with an employer (Sullivan 2004). A sarong employer brand attracts better candidates (Collins and Stevens, 2002) and shapes their expectations towards their place of work (Lievens and Highhouse, 2003).

Research conducted by Chenerson Group has shown that more than 75% of respondents would prefer to work for a company which enjoys an excellent reputation rather than for an enterprise, which is hardly recognised, even if salary paid by the latter were higher. In addition, nearly 50% of all American employees indicate that the brand of their employer plays the key role in their employment decisions (Urbanek 2002). These results indicate high importance of employer's brand, which, in many cases, is a factor critical to employment (the external company's brand) or to retaining employees (the internal employer's brand).

Both personality-related factors and factors connected with the current status of the labour market affect employees' staying with or leaving an enterprise. However, research has shown that those who have the opportunity of ex pressing their lack of satisfaction are less inclined to leave than those who do not have such option (Spencer 1986). Decisions about leaving are

typically caused by the following: excessive stress at work, lack of satisfaction (Stel et al., 2002). A lot of research has pointed to the impact of employer brand on shaping satisfaction. Furthermore, it is material how employee satisfaction affects the way in which the brand is shaped. Research has show that employees who draw more satisfaction from their work as more effective in starting client relationship (Heskett et al., 1997).

POURPOSE OF THE RESEARCH

The purpose of the research was to identify factors affecting employer selection in the studied group as element affecting creation of employer's brand. By forming the profile of features that the most desirable employer should posses and its subsequent confrontation with images of companies on the Polish market and their popularity among potential employers, a list of the most powerful employer brands has been created. Next, factors affecting choice of employer brand were analysed. The final part of the research was focused on the group of employees and aimed at identifying factors affecting employee loyalty towards their employers.

RESEARCH METHODOLOGY

Brand power valuation is not supported by any uniform methodology. Unlike other areas, this area is susceptible to actions taken by individuals, which cannot be verified in other market conditions. In fact, the brand value evaluation is a relatively new phenomenon and, in spite of employing many well-proven tools, it has not succeeded yet in developing techniques of universal nature. For the purpose of the research, appropriately modified popular marketing models were used. In the research, a model of employer's brand power was tested, where the model was dependent on: company's properties, its presence in the media and opinion it enjoyed. When testing the process of measuring the power of employer's brand, a consumer decision-making model and the brand value pyramid were used as the basis (Keller 2001, Franca, Pahor 2007). It was assumed that the pyramid of employer's brand power had three levels. Recognition (employer's brand is recognised and its attributes and key messages are known), significance (the company is taken into consideration as a potential employer) and choice of employer (the employer is chosen by the employee). Respondents included students and potential or then-current employees. A list of 40 companies, leaders of national rankings, operating in the area of new technologies, economy and management was prepared. The name of the ranking was Top Employers 2008 and it was prepared by Hewitt Associates (http://was7.hewitt.com), a consulting and outsourcing company, which specialised in HR management solutions. To create the pyramid of employer's brand for an average company, on the basis of performance reported by analysed companies first the pyramid of employer's brand was created for each company separately. Next, by simple arithmetic, the results were extrapolated. The same procedure was followed when creating brand pyramids for an average international company and national company, selecting appropriate performance of international and national companies. Subsequently, factors affecting employer selection, employer attractiveness, etc. were analysed. Next, on the basis of the loyalty pyramid prepared specifically for this purpose, respondents were asked to answer the following question: If your place of work/employer were included in the list presented in part one, would you: make it your first choice, consider it as a possible option of employment, and not consider it as a possible employment option.

The research was conducted in the form of an electronic questionnaire. A network tool was created to collect results from respondents when ready and to visualise the results

automatically in an analysis-friendly format. Because of formal limitation of the size of the paper, selected results can be only presented.

PRESENTATION OF RESEARCH RESULTS
DESCRIPTION OF THE ANALYSED GROUP

471 respondents took part in the research, including students (253) and graduates of technical studies (predominantly from the area of new technologies) and business studies and employees (168) representing enterprises of various sizes and capital from various industries. Female and male participants of the research represented 49% and 51% of respondents, respectively. 31% of respondents aged below 25, 49% of respondents belonged to 25-35 age group, 15% of respondents belonged to the age group between 36 and 45 while 5% had between 46 and 55 years of age. The majority of respondents (41%) has been with their employer for a period shorter than 3 years, 40% for a period from 4 to 8 years, 14% for 9 to 13 years, and 5% for 14 to 18 years. The highest percentage of respondents has been employed by the state administration - 18% while 15% work in the industry sector and 12% in the service sector. Sectors of transport and logistics as well as the sales sectors had equal 10% representation. The highest percentage of respondents indicated their employment in state institutions (22%), 18% of respondents are employed in limited liability companies with the majority of shares held by Polish shareholders and 22% of respondents are employed in joint stock companies with the majority of shares held by Polish shareholders. Companies with foreign majority shareholders employ: 22% of respondents – joint stock companies and 8% of respondents – limited liability companies. These results demonstrate that the majority of respondents works for large enterprises (41%). A medium size employer was indicated by 30% of respondents, while 19% of respondents are employed by small enterprises.

RESULTS OF REARCH ON EMPLOYER BRANDING

When comparing brand pyramids of employers representing average international and national companies, one can see that their recognition in both cases in similar and reaches 80%. Still, when it comes to significance in the process of selecting potential employers, internationals are in favour with a difference of 10%.International employers take also priority in the process of choosing employers – an international employer is seven times more likely to be chosen over a national employer. A large international company would be the employer of choice for the majority of potential employees. Furthermore, nearly all respondents indicated sectors or industries of their preference on the labour market. Only 2% declared the issue to be of no importance.

In the students' ranking of the best employer Google came first (18%) followed by ABB (12%) and Delphi (9%).

Those currently employed had a slightly different approach to the issue. In this group, brand recognition is markedly lower – 60.02. The majority has a preference for large Polish enterprises. A 10% difference in favour of Polish companies is shown at the stage of considering prospective employers. Polish employers tend to be selected more often (eventually, respondents demonstrated equal preference for Polish and foreign enterprises) although the number of foreign employers on the list was 2.5 higher than the number of Polish enterprises. Employees believe that the best employers were the National Bank of Poland and a Polish insurance company PZU (each selected by 11.5% of respondents) as well as bank

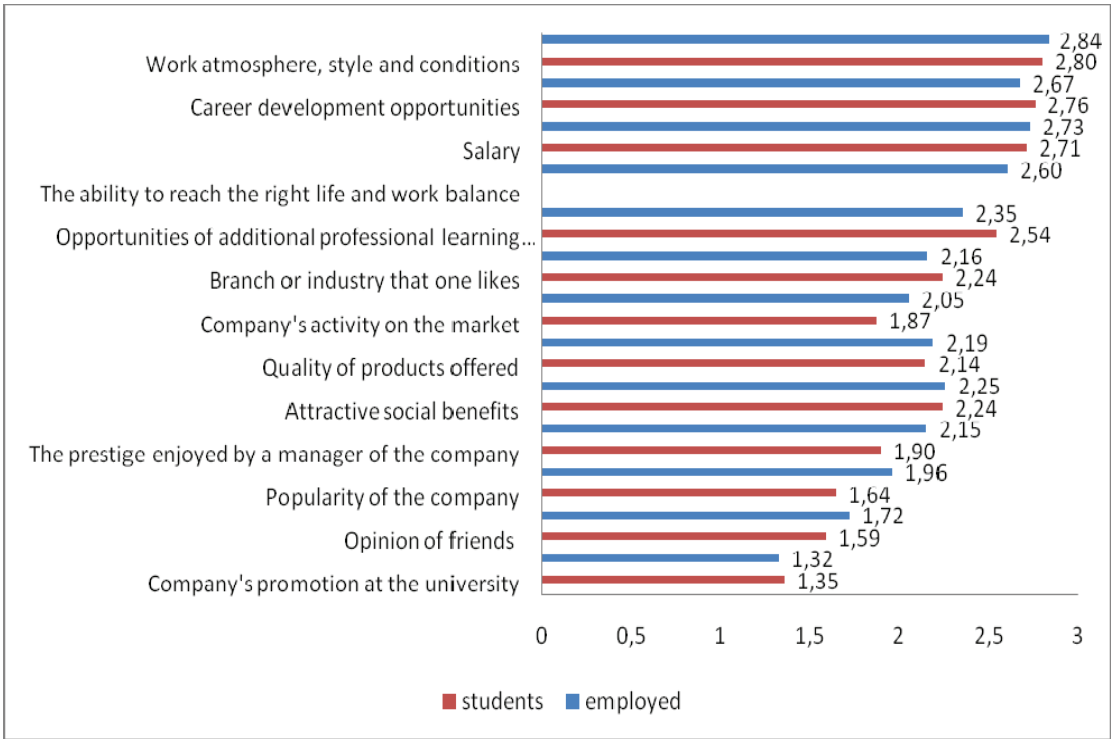
PKO B.P. selected by 9.6%. The result could be interpreter in the context of the global crises which also affects foreign companies operating on the Polish market. These companies often do not hesitate to take some drastic steps such as downsizing their operations and redundancies. Polish large enterprises are still considered relatively stable and safe employers. As little as 1.2% of respondents indicate that the sector is of no importance while more than 1/3 of respondents indicated finance and banking as their preferred sector.

FACTORS DECISIVE FOR SELECTING EMPLOYER

Work atmosphere, style and conditions topped ranking of the most desirable factors which attract potential employees. Professional development opportunities, salary and the opportunity to maintain the right life-work balance ranked equally high.

The graph below compares results in the groups of students and the employed.

Graph 1. Factors decisive when choosing employer.



Source: own study

Two factors characteristic for your generation were selected: the importance of professional career opportunities, which is one of the three crucial aspects when considering an ideal work/employment and the possibility of reaching a good life-work balance.

By using Mann-Whitney U test, material differences between responses given by female and male respondents were determined. Female student respondents expressed the highest appreciation of the following factors: the prestige of working for the company (p=0.02093), the popularity enjoyed by the company (p=0.02009), style of work and atmosphere at work (p=0.02835), attractive social benefits (p=0.035494) as well as opinion of friends (p=0.22037). Male respondents attached the highest importance to the salary and differences

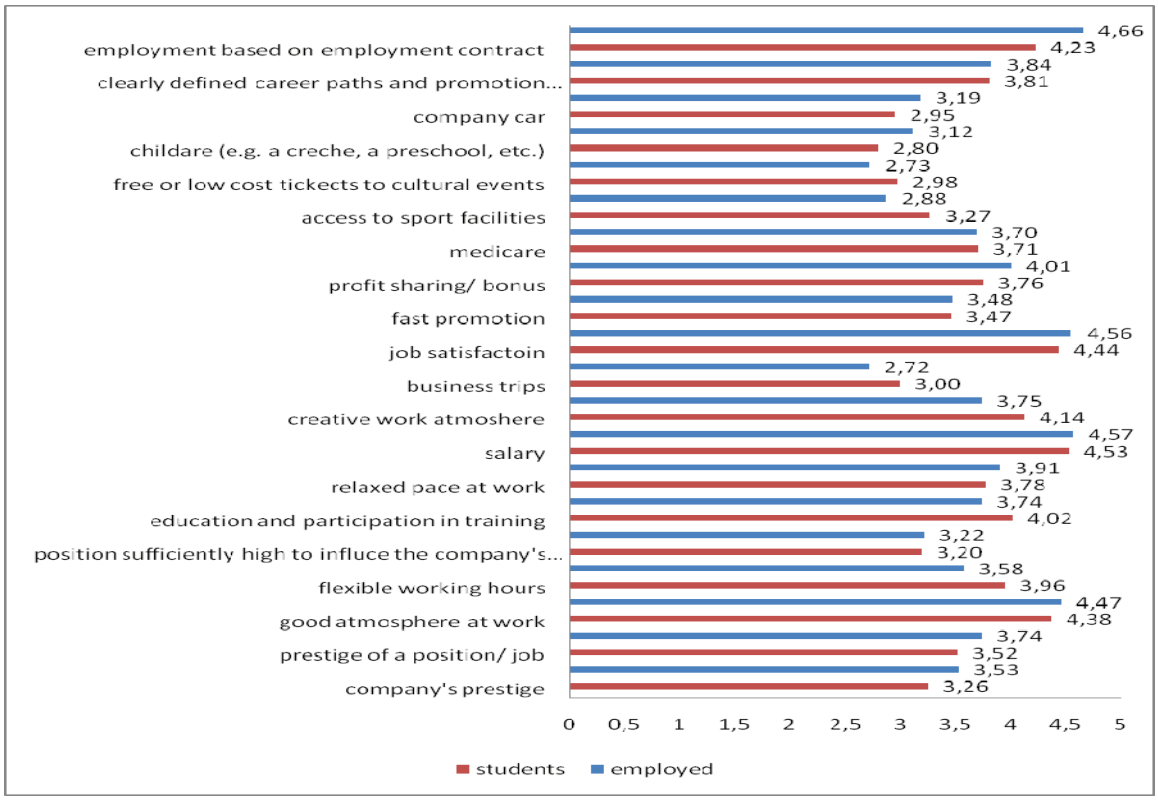
in this aspect are very clear (p=-.000014), development of professional career (p=0.006885) and sector/industry which they liked (p=0.002093). In the group of the employed, the test demonstrated some material differences between female and male respondents: female respondents expressed the highest appreciation of the opportunity of reaching a good life-work balance (p=0.070491) and attractive social benefits (p=0.0086930) and male respondents their preference of the sector/industry (p=0.028772).

By applying Kruskal Wallis' test we could see that together with the period of employment (some students had had the opportunity of traineeships, apprenticeships and part-time employment during the final years of their studies) their value more their salaries (p=0.0370), the opportunity to receive additional training and learning opportunities (p=0.0164), the opportunity to reach the right life-work balance (p=0.033), sector/industry of their liking (0.0005) and the company's activity on the market (p=0.0289). As regards the employed respondents, no material differences could be found. It may indicate that young employees learn about the realities, their own needs and importance of specific factors after one year of employment. No material changes could be seen here in subsequent years.

FACTORS DECISIVE FOR EMPLOYER'S ATTRACTIVENESS

Next, the impact of individual enterprise components on the pyramid of employer's brand was tested. On this basis, the profile of features of the most desirable employer was drawn. Respondents, both students and employees, could assign weights to factors dominant when assessing work in a company. Below, differences in responses given by both groups are presented.

Graph 2. Factors decisive for employer's attractiveness.



Source: own study

Factors connected with safe and long-term employment, job satisfaction, work atmosphere and development opportunities received the highest appreciation. It is interesting to mention that salary is no longer the one and main priority, as it used to be until very recently.

Levels of salary received the highest weight in the ranking of the most desirable factors which attract potential employees. Satisfaction from work and good atmosphere in the workplace were considered equally important. In addition, respondents highly appreciated the aspect connected with employment stability i.e. employment based on an employment contract.

By using Mann-Whitney U test, material differences between responses given by female and male respondents were determined. Female student respondents expressed the highest appreciation of the following factors: the company's prestige (p=005552), good atmosphere at work (p=0.033346), medical care (p=0.000334) and reduced price tickets to cultural events (p=0.001562). Among male respondents, salary (p=0.017311) and profit-sharing topped the ranking (p=0.000092). In the group of the employed, the test disclosed material differences between female and male respondents in terms of the following factors: the company's prestige again (p=0.025900), good atmosphere at work (p=Male7812) as well as flexible working hours (p=0.0010028), relaxed pace of work ((0.012877) and employment based on the employment contract (p=0.038205). Statistically, male respondents tended to point more often to a position giving influence on the company's strategy (0.016184) and business trips (p=0.010750).

With Kurskal Wallis test we could see that, with longer history of employment, employees tend to appreciate more factors such as job satisfaction (p=0.0363), profit-sharing and bonuses (p=0.0003), prestige of their position/job (p=0.0168), good atmosphere (p=0.0309) or access to sport facilities (p=0.0412).

The attractiveness of business trips decreases among the employed as the number of years of their employment grows (p=0.0470). Employees with history of employment up to 3 years appreciate very much employer's support in childcare (p=0.0279).

FACTOR AFFECTING THE LOYALTY PYRAMID

Below responses given by employees of analysed companies on factors affecting employee loyalty towards employers are presented.

Table 1 Factors affecting employee loyalty

CREDIBILITY	N	Spearman's correlation factor	t(N-2)	p level
We have open communication	161	-0.144419	-1.84034	0.067582
Information is available	***160***	***-0.191830***	***-2.45689***	***0.015096***
The vision is implemented with consequence	***159***	***-0.238993***	***-3.08394***	***0.002414***
The company is managed with professional competence	***160***	***-0.172986***	***-2.20768***	***0.028708***
The management keeps its promises	***162***	***-0.188611***	***-2.42937***	***0.016232***

RESPECT FOR EMPLOYEES	N	Spearman's correlation factor	t(N-2)	p level
Employee professional development is supported	161	-0.131513	-1.67285	0.096324
Efforts to make the company the best working place are continued	***162***	***-0.173543***	***-2.22899***	***0.027208***
Employees are appreciated	162	-0.093181	-1.18381	0.238244
Employees participate in the decision-making process	161	-0.129368	-1.64509	0.101927
Employees are treated with respect	***160***	***-0.200404***	***-2.57120***	***0.011057***

FAIR ATTITUDE TOWARDS EMPLOYEES	N	Spearman's correlation factor	t(N-2)	p level
All employees are treated in the same way - no one is discriminated	***160***	***-0.233980***	***-3.02506***	***0.002902***
Fair awards	***160***	***-0.208732***	***-2.68282***	***0.008077***
Uniform employment and promotion criteria	***161***	***-0.166171***	***-2.12488***	***0.035142***
Employees receive fair remuneration for their work	***162***	***-0.283485***	***-3.73923***	***0.000257***
I believe that if I am treated unfairly and make a complaint, I will be listened to and heard	***161***	***-0.169492***	***-2.16859***	***0.031600***

IN-COMPANY RELATIONS	N	Spearman's correlation factor	t(N-2)	p level
The atmosphere in the company is nice an friendly	***162***	***-0.330912***	***-4.43564***	***0.000017***
Everyone has the right to be himself/herself	***162***	***-0.157452***	***-2.01678***	***0.045391***
Everyone has the right to express their opinions	***159***	***-0.157604***	***-1.99976***	***0.047251***
I may count on support of other employees	***159***	***-0.192047***	***-2.45199***	***0.015303***

PRIDE	N	Spearman's correlation factor	t(N-2)	p level
I am proud to work in my company	***162***	***-0.287503***	***-3.79697***	***0.000208***
I am proud of my work and my contribution	***162***	***-0.278306***	***-3.66512***	***0.000336***
I am proud of work performed by my team	***162***	***-0.237755***	***-3.09617***	***0.002315***
I am proud of products/services produced by my company	***162***	***-0.170969***	***-2.19492***	***0.029610***
I am proud of the role played by my company in the society	***161***	***-0.244424***	***-3.17848***	***0.001779***

SATISFACTION	N	Spearman's correlation factor	t(N-2)	p level
My company is a wonderful workplace	***160***	***-0.408882***	***-5.63187***	***0.000000***

Source: own study

Analysing the above-presented factors we can see that loyalty is predominantly affected by work satisfaction and, secondly, by pride from working in a company, the company's activities and own contribution and by fair treatment and in-company relations. It would be interesting to find the reason for respect for employees ranking last in the hierarchy of factors.

CONCLUSIONS

It is worthwhile to introduce selected practices applied by companies which occupy the tops of best employers' rankings. It will be certainly helpful to build an organisational culture that would make all employees feel welcome and appreciated and where they can become a true asset for their employer. Although it takes a lot of effort and internal determination of management to build a strong employer's brand, this effort may be beneficial and profitable in the end. A strong employer's brand enhances effectiveness of the recruitment process, has a significant impact on retention of key employees and talents, increases productivity, loyalty and commitment of staff and, eventually, improves the employer's financial performance.

The research confirms that factors such as work atmosphere, style of the organisation and work conditions have a material impact on the employer brand. Other factors appreciated by respondents, graduates in particular, include the opportunity of development in the company. Salary is also an important but not a priority factor. Work satisfaction is of major importance when it comes to employee loyalty. In addition, employee loyalty is affected largely by pride for working in the company, price in the company's activities, in-company relations and fair treatment. Company's credibility is also appreciated. There is no doubt that the strength of employer brand is a complex issue dependant on many factors. The research has shown one possible solution; nevertheless, the issue requires further and in-depth research.

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PRODUCTION EFFICIENCY: EVIDENCE FROM TAIWANESE BUSINESSES IN CHINA

Li-Hua Huang, National Taipei College of Business, Taipei, Taiwan
dbacpa@webmail.ntcb.edu.tw
Hsing-Chin Hsiao, National Taipei College of Business, Taipei, Taiwan
thinking@webmail.ntcb.edu.tw
Jui-Chih Wang, National Taipei College of Business, Taipei, Taiwan
jcwang@webmail.ntcb.edu.tw

ABSTRACT

This paper investigates the effect of the Taiwanese foreign direct investment on the operating efficiency in China. We applied data envelopment analysis (DEA) to operations data for 3,506 firms over the four year period (2004-2007). We found that companies located in the economic (technology) development zones benefit from lower tax rate privileges than their counterparts in the development and the industrial zones, and that their operating efficiencies are better with statistical significance. The high technology industry receives better tax incentives but requires more capital investment and the operating risks are higher. As the company size increases, the operating efficiencies worsen. The greater capital requirement and the difficulties in achieving economies of scale are the major reasons for the deterioration. The averaged invested year is shorter and the payback period is longer rather than others industries. The major production type of the high technology sector in China is original equipment manufacturer (OEM) with lower margin rate compared with the upstream value chain of the high technology sector. Finally, when the company has higher sales growth exhibits its better operating efficiency.

Keywords: Data envelopment analysis (DEA); Operating efficiency; Foreign direct investment (FDI); Economic (technology) development zones; Tax incentives.

INTRODUCTION

In order to attract foreign investment and enhance economic performance, a country needs to obtain at least one core efficiency-creating competency among the key inputs of wages, education, and infrastructure (Bunyaratavej et al., 2008). Governments often provide various tax incentives to attract investment in order that the businesses may satisfy various employment levels, locations, export requirements, and performance requirements (Davies and Ellis, 2007). Various studies have focused on the impact of foreign direct investment

(FDI) on the host country's productivity but have demonstrated inconsistent results (Buckley et al., 2007b). Buckley et al. (2007a) claimed that the nationality of the foreign investors has a significant impact upon the productivity, with the spillover effects being most forthcoming from the overseas Chinese (Hong Kong, Macau, and Taiwan; HMT) multinational enterprises, but not from the Western firms. China initiated the high and new technology industry development zones to promote its economic growth and social progress (Ma and Goo, 2005). Hu (2007) suggested that the FDI contributes to the productivity growth in the technology parks of China, while Havrylchyk and Poncet (2007) claimed that incoming foreign investment provides additional sources of capital to China.

Initiated by the 1978 market reforms, China's economic miracle and phenomenal growth have been considered critical and interesting issues (Wu, 1995, 2000; Wang and Yao, 2003; Henderson et al., 2007). China has attracted investment from 80% of the world's top 500 enterprises (Powers, 2001). In 1980, China's industrial sector consisted almost on state- and collective-owned enterprises. Until the mid-1990s, the most dramatic method of ownership reform in Chinese industry was the entry of new non-state firms, including the foreign investment from the investors in HMT, [1] and from foreign sources, primarily OECD and South-east Asian countries. Although many of these foreign sources and HMT firms had previously been state- or collective-owned enterprises that were converted into joint ventures as a vehicle for FDI, the restructuring of these firms represents an important form of new entry into China's industrial enterprise system (Jefferson and Su, 2006). Concerning the Chinese economic growth issue, researchers have concentrated on the productivity changes deriving from the various reform policies and these have been expansively reported in the literature (Wu, 1995, 2000; Wang and Yao, 2003; Henderson et al., 2007). Wu (1995) suggested that it is worthwhile to compare the different reform policies in terms of productivity and efficiency performance. Previous studies of productivity have focused almost on state- and collective-owned Chinese firms. The growing importance of foreign-invested firms is significant to investigate for both policymakers and FDI managers (Jefferson et al., 2000). Therefore for FDI, it is imperative to examine whether the invested firms can gain higher operating efficiency (Baek, 2004).

The meaning of higher efficiency is equivalent to being more competitive and profitable for business operation (Tsai et al., 2006). We apply data envelopment analysis (DEA) to measure business performance (Ma and Goo, 2005; Düzakin and Düzakin, 2007; Asmild et al., 2007)

1 Regarding the FDI in China, the investment was US $40.319 billion in 1999. This rose to US $74.768 billion in 2007. The majority resources of FDI in China are 41.35% from Hong Kong and Macau. Taiwan at around 5.66% is the fifth largest resource of FDI in China. According to the Taiwan's Investment Commission of the Ministry of Economic Affairs, the approved investment to China was US $1,252.78 million in 1999. The investment increased to US $9,970.55 million in 2007. Among the FDI investment areas, Kiangsu province accounted for 32.33% and the major industry was the electronic parts and components manufacturing for 15.97%.

and analyze the operating efficiency for Taiwanese FDI in China during the four year period 2004-2007 for a sample of 3,506 firms in China. An investigation of China's productivity performance provides valuable insight into the understanding of that country's spectacular growth over the last two decades (Wu, 2000). Our results indicate that China provided Taiwanese businesses invested in the economic technology development zones and the economic development zones with better operating efficiencies than Taiwanese investments in the other zones. The tax incentive programs lowered the tax expenses and improved the operating efficiencies. Furthermore, our study results reveal that Taiwanese investments in the high technology sector result in deteriorated operating efficiencies due to the higher capital requirements and greater operating risks. In addition, the averaged invested year is shorter and the payback period is longer rather than others industries. The major production type of the high technology sector is original equipment manufacturer (OEM) in China. Therefore, the margin is relative smaller than upstream value chain of the high technology sector.

Our study contributes to the literature in at least two ways. Firstly, our study provides evidence of the operating efficiency performance of the Taiwanese FDI in China. Evaluating how the tax incentives and industry characteristics affect efficiency in China provides insight for current and potential foreign direct investors seeking to improve operating performance, and for policymakers considering foreign direct investment. Secondly, our study provides additional empirical evidence on the impact of various factors on operating efficiency. Many governments have used a variety of tax and financial incentive programs to foster economic stimulation influencing business relocation and expansion. Despite the large amount of attention and resources that policy makers have devoted to these incentive programs, there is little systematic empirical evidence concerning the impact of business incentives (Lee, 2008). Chen et al. (2006) found that there is a lack in related empirical studies. Our research might fill the gap in the literature.

LITERATURE REVIEW

China's Tax Incentive Programs and Hypotheses Development

The Chinese government has offered a number of investment incentives, such as tax concessions, an abundant supply of cheap labor, and a large domestic market for FDI. The success of this policy is demonstrated by the large and increasing inflows of FDI (Chow and Fung, 1997). Prior to 2008, the highest corporate tax rate in China was 30%, plus a local 3% tax rate. The aggregate tax rate would thus be 33%, which is higher than the highest corporate tax rate of 25% in Taiwan. In China, there are different laws and regulations for foreign

companies to enjoy permanent local tax exemptions and China also provides various tax incentive programs in terms of different investment locations and industries. The approved productive FDI corporate tax rates promulgated by China's State Council for the economic technology development zones located in the coastal cities are 15%. For the productive FDI located in the old cities and coastal economic development zones, approved by cities, counties, and regions, these rates are 24%. Furthermore, productive FDI businesses operating more than ten years are exempted from corporate taxes in the first and second profitable years (the first five years' losses are deducted in calculating the first operating profit year). From the third to fifth years, the actual corporate taxes imposed are half the stipulated corporate taxes: this is the so-called "two (years) exemptions and three (years) half-tax deductions" incentive. The non-productive FDI businesses are not eligible for these tax privileges. For the productive FDI businesses with some non-productive operations, if the productive sales revenues are over 50% of the total sales revenues within the tax deduction period, the businesses are either exempted or the tax is reduced for the current year subject to the approval of the tax authorities. If the productive sales revenues are less than 50%, there shall be neither exemption nor tax reduction permissible even within the tax deductions period. Apart from the economic development zones and the economic technology development zones, the statutory regular higher tax rate is imposed on all other zones, such as the development zones and industry zones.

Although the economic reforms have been beneficial to all the regional economies in China, in general, those located along the coast of China have been able to grow much faster than those located in the interior provinces of the Central and Western parts of the country (Henderson et al., 2007). Klimberg and Ratick (2008) suggested that the location might affect the efficiency performance. They assumed that the optimal and most efficient location derived from the attributes of the local labor markets, the available infrastructure, and other necessary resources. The advantageous geographical location of the coastal provinces has enabled them to attract large inflows of FDI as well as of domestic capital (Zhang and Zhang, 2003). China initiated the high and new technology industry development zones to promote its economic growth and social progress (Ma and Goo, 2005).

The tax cost is part of the business operation cost. In order to attract foreign investment, China has established the state-level economic (technology) development zones. Besides the lower tax incentive programs to attract FDI, these zones offer superior infrastructures (such as discounts in terms of the land costs, construction expenses, utilities bills, transportation costs, and other communication expenses), better worker fringe benefits, and insurance welfare. Therefore, we propose the following hypothesis:

H_1: If the Taiwanese FDI business invested in the economic (technology) development zone for the tax incentive, the operating efficiency is higher.

Besides the investment location selection, the type of industry is a critical decision. In July 2000 China's State Council announced the "Software industry and integrated circuit (IC) industry development policy". In the IC industry, the Taiwanese investment is over RMB $8 billion and the integrated circuit line width is less than 0.25 μm (micrometer). The Taiwanese investors are eligible to apply for the "five exemptions and five half-tax deductions" tax privileges. A Taiwanese software company established in China would benefit from the corporate tax incentives. The new software company, once approved, would benefit from the policy of "two exemptions and three half-tax deductions" starting from the profit year. In order to encourage the domestic software development and in-house production, the statutory value-added tax rate of 17% is applicable before 2010. If the actual tax rate is over 3%, the excess tax is imposed and deducted instantaneously. This policy encourages the Taiwanese businesses to focus on R&D and reproduction expansion. The abovementioned industry incentive programs have attracted many global software and IC industries to China. Therefore, we propose the following hypothesis:

H_2: If the Taiwanese FDI business invested in high technology industry for the tax incentive, the operating efficiency is higher.

METHODOLOGY

Data Envelopment Analysis (DEA) and Test Statistics

Performance evaluation and benchmarking have become important continuous assessment and improvement tools for firms in a business environment facing global competition (Cook et al., 2004). Contrary to the incompleteness of a single performance evaluation measure, benchmarking models integrate multiple performance measures. One such model is DEA, a linear programming technique introduced by Charnes et al. (1978) and extended by Banker et al. (1984). DEA has been proven to be an effective method to evaluate the firm's relative performance (Banker et al., 1989; Mensah and Li, 1993; Sherman and Zhu, 2005; Düzakin and Düzakin, 2007; Tseng et al., 2009). Our study applies DEA for the measurement of a firm's operating efficiency.

We adopt an output-oriented efficiency measure by assuming that firms maximize output given the available inputs. This output-oriented approach measures how much output can be generated from a given level of inputs (Chang et al., 2004). The output-oriented efficiency

measure θ_j is estimated by the following DEA model:

$$\theta_j = Max\theta \tag{1.0}$$

$$\text{s.t. } X_{ij} \geq \sum_{j=1}^{N} \lambda_j X_{ij}, i = 1,...,I \tag{1.1}$$

$$\theta Y_{rj} \leq \sum_{j=1}^{N} \lambda_j Y_{rj}, r = 1,...,R \tag{1.2}$$

$$\sum_{j=1}^{N} \lambda_j = 1 \tag{1.3}$$

$$\lambda_j \geq 0 \tag{1.4}$$

where j is the firm being evaluated, θ_j is the estimated inefficiency for firm j, X_{ij} is input *i* for firm $_j$, Y_{rj} is output *r* for firm $_j$, and λ is the weight placed on each firm. Model (1) is constructed under the assumption of variable returns to scale and referred to as the BCC model of DEA (Banker et al., 1984). If a constant return to scale is maintained instead, equation (1.3) is removed and the resulting model is labeled as the CCR model of DEA (Charnes et al., 1978).

Prior research applied two conventional parametric based tests to examine efficiency differences between two groups of DMUs: Welch's mean test; and the Mann-Whitney test (Siegel and Castellan 1988). However, Banker and Chang (1995) documented that these two test statistics did not perform as well as those of the DEA-based tests. The inefficiency θ_j is a consistent estimator (Banker, 1993). We can employ two DEA-based test statistics[2] (Banker 1996; Banker and Chang 1995) to evaluate efficiency differences.

If θ_j is assumed to be exponentially distributed, then, to test the null hypothesis (that the two groups have no efficiency difference), we can use the following equation:

$$T_{EXP} \equiv \left[\sum_{j=G1}^{N1}\left(\theta_j - 1\right)/N1\right] / \left[\sum_{j=G2}^{N2}\left(\theta_j - 1\right)/N2\right] \tag{2}$$

which is evaluated with *F*-distribution with (2*N1*, 2*N2*) degrees of freedom. *N1* and *N2* are the number of two groups sample respectively.

2 See Banker (1996) for details on the construction of DEA-based tests for efficiency difference.

If the θ_j is assumed to be half-normally distributed for firms, then we can test the null hypothesis against the alternate hypothesis, described above, by employing the test statistic given by

$$T_{HN} \equiv \left[\sum_{j=G1}^{N1} \left(\theta_j - 1 \right)^2 / N1 \right] / \left[\sum_{j=G2}^{N2} \left(\theta_j - 1 \right)^2 / N2 \right] \quad (3)$$

which is evaluated by the F-distribution with (*N1*, *N2*) degrees of freedom.

Multivariate Analysis

In order to evaluate the influence of factors on operating efficiency for Taiwanese businesses in China, our research design, using the two-stage procedures represented in equation (4), is motivated by prior research. Banker and Natarajan (2008) have provided theoretical justification for the use of two-stage models in DEA to evaluate the contextual variables affecting DEA efficiency scores.

$$\ln\theta = \beta_0 + \beta_1 AREA + \beta_2 ELEC + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (4)$$

where $\ln\theta$ is the natural logarithm of the operating inefficiency estimator θ obtained from equation (1). *AREA* is a dummy variable that takes the value of 1 to indicate the firms located in the economic development zones or economic technology development zones and businesses that receive more tax incentives. *ELEC* is a dummy variable that takes the value of 1 to indicate high technology industry. Company characteristics may contribute to operating efficiency. We choose two characteristics, firm size and production growth, as the control variables (Hamblin and Iyer, 1996). Dhawan (2001) examined the production of large and small US firms for the 1970-1989 period and found that the small firms are significantly more productive than their larger counterparts. Margono and Sharma (2006) also support the finding that size contributes to inefficiencies among the textile, chemical, and metal industries. We measure the natural logarithm of total asset (*SIZE*) to proxy for the firm size. Firm growth is an important precondition for the achievement of the other financial goals of business (Geus, 1997; Reynolds, 1993; Day, 1992; Phillips and Kirchhoff, 1989). Prior literature had found that firm growth contributed to performance and some studies controlled annual growth for research (Chang and Choi, 1988; Dunne and Hughes, 1994; Koh, 2002). We measure the growth rate of total sales growth (*GROWTH*) to proxy for firm growth. Based on the economics theory, there is incentive toward maximization of profit for business. Upon receipt of a customer's order, the business would evaluate whether there is marginal utility in this order. Under normal business operation, sales revenues and profit would increase continuously along with better sales growth and operating efficiency. Finally, we

include three years independent control variables *DYEAR5*, *DYEAR6* and *DYEAR7*.

Data

The sample of Taiwanese enterprises in China that is included in this study is derived from the *Top 1,000 Taiwanese Businesses in China* database by China Credit Information Service, Ltd. The database[3] contains data on the top 1,000 businesses each year ; however the data given only consists of the total revenue, total assets, net value of firm, after-tax income, capital, number of employees, and growth rate of total revenue for each business. Our study examines four annual periods from 2004 to 2007. We begin with an original total sample of 4,000 firms and eliminate those firms with incomplete data. The final sample consists of 3,506 Taiwanese businesses in China, comprising 861 firms in 2004, 714 firms in 2005, 951 firms in 2006, and 980 firms in 2007.

DEA is an approach for measuring the relative efficiency of peer decision making units (DMUs). Färe and Grosskopf (1996, 2000), Seiford and Zhu (1999), Zhu (2000), Chen and Zhu (2004), and Kao and Hwang (2008) used the two-stage DEA method[4] and identified revenue as an intermediate product. Therefore, we did not choose total revenue as an output variable. Based on prior literature (Düzakin and Düzakin, 2007; Mok et al., 2007; Zofio and Prieto, 2007; Lee et al., 2008; Goto et al., 2008; and Tseng et al., 2009) and data availability, we select one output and two inputs for production. The output variable is measured by after-tax income for each firm. The input variables are the number of total employees and the paid-in capital of the firm.

EMPIRICAL RESULTS

Descriptive Analyses

We investigated the production efficiency of Taiwanese businesses in China. Based on Table 1, Panel A, the paid-in capital mean of the four-year period for Taiwanese businesses is RMB $183,584.44, with the paid-in capital being highest in 2006. The mean for the number of the employees was 1,847.4, and that for the after-tax income was RMB $35,698.78. The numbers of the employees and the after-tax income increased incrementally each year.

With regards to the investment location, we combined the economic technology development zone and the economic development zone as (*EA*) and the other zones as (*NEA*)

3 The database is not disclosed to public and offers limited data to analyze.

4 DMUs have a two-stage structure in which all the outputs from the first stage are the only inputs to the second stage, in addition to the inputs to the first stage and the outputs from the second stage. The output from the first stage to the second stage is called intermediate product.

for location selection analysis. From Panel B, it can be seen that the economic technology development zone and the economic development zone took 15% or 24% lower tax rate privileges than the development zone, industry zone, and others. Therefore, the Taiwanese businesses have tax incentives to invest more capital at either the economic technology development zone or the economic development zone. The numbers of the employees are lesser inputs but generated higher after-tax income and paid-in capital.

Pertaining to the industry analysis, the top three highest paid-in capital industries are: the glass industry; the communications industry; and the rubber industry. The top three biggest employers are: the communications industry; the leather industry; and the optic industry. The top three best performing industries in terms of after-tax income are: the communications industry; the high technology industry; and the glass industry. If we compare the high technology industry (*EI*) with the others industries (*NEI*) (Panel C), generally speaking, a larger paid-in capital and a greater number of the employees in the high technology industry generates higher after-tax income compared with the other industries.

Before China's new 2008 corporate tax law inauguration, foreign companies (sole proprietorship or joint venture) had a greater number of tax privileges. These privileges included: a halved export tax; a tax credit for 40% of any re-investment; a halved tax rate for advanced technology businesses; an exemption from corporate tax for investment in the purchase of a Chinese domestic facility; and the treatment of a foreign company as an investment company with the profit (divided) derived from the invested company being exempted from corporate income tax. However, after the 2008 corporate tax law amendment, the tax privilege principles have focused on the industry privilege rather than on the previous regional privilege.

Operating Efficiencies Analyses

Based on Table 2, Panel A, the operating efficiency value analysis demonstrates that the mean of the four-year period efficiency value is 2.41. In 2004, the efficiency value reached its best value and deteriorated thereafter. The mean of operating efficiencies at the economic development zone is 2.38, which was better than the economic technology development zone, development zone, industry zone, and others. Based on Panel B, the mean of the operating efficiency (*EA*) is superior to the others (*NEA*).

From the industry operating efficiency analysis, the top three best industries are: the biotechnology industry; the cement industry; and the paper industry. As shown in Panel C, we use dichotomy for the high technology industry (*EI*) and others industries (*NEI*), and the mean of the high technology industry (*EI*) at 2.68 is worse than the mean of other industries

(*NEI*). The possible reason is that the high technology industry requires more land, capital, and employees compared to the others. Moreover, the high technology industry suffers from higher operating risks as well as being subject to more government restraints. Therefore, the operating efficiency of the high technology industry is worse than that of the other industries.

Univariate Mean Test

Table 3 exhibits the difference in efficiency test results for the combination of the economic technology development zone and the economic development zone, as *EA,* compared with the rest of the three zones, as *NEA* (the development zone, the industry zone, and others). The *EA* take the tax advantage of either 15% or 24% yet show a worse operating efficiency. Although this is inconsistent with the predictions of our research, it is the only statistics significant shown in the DEA test. Regarding the Taiwanese businesses invested in the high technology industries (*EI*), all the tests, comprising the parametric *t* test, the non-parametric Mann-Whitney test, and the DEA test, demonstrate this statistics significant. The high technology industry enjoys various tax privileges, but the huge invested paid-in capital, the vast number of employees, and the high operating risk compared with the traditional industries results in a worse operating efficiency than its counterparts (*NEI*).

Multivariate Regression Analyses

China introduced the state-level economic zone in order to attract foreign investment through lower tax rates. For foreign invested businesses approved by the China's State Council, either at the economic development zones or the economic technology development zones at the coast cities, the corporate tax has become 15%. The foreign invested production-style businesses approved by the city, county, or region at the old cities and in coast economic development zones still need to pay the 24% corporate tax. Table 4 of the multivariate regression analysis shows the coefficient of *AREA* (α_1) is significantly negative with operating efficiencies consistent with the prediction of our research hypotheses H_1. If the Taiwanese invested businesses are located in the economic (technology) development zones, they receive more tax privileges than in the other zones. In addition, their operating efficiencies are better with statistics significant. China provides the 15% or 24% low corporate tax rates to the FDI firms located in the economic (technology) development zones. When compared to the 25% statutory tax rate in Taiwan, the lower tax incentives trigger Taiwanese FDI approaches to these economic (technology) development zones. The lower tax cost promotes the operating efficiency.

China aims to promote high technology industries by providing more tax incentives. There

are the low 15% corporate tax rates for high technology and advanced facility industries as well the "two (years) exemptions and three (years) half-tax deductions" or "five (years) exemptions and five (years) half-tax deductions" tax incentives. Our empirical study results found that the coefficient of *ELEC* (β_2) is significantly positive with operating efficiencies for the Taiwanese invested high technology industries, whereas their actual operating efficiencies are worse, which is inconsistent with the predictions of our research, so we are unable to support the hypotheses H_2. We conclude that tax incentives might only be part of investment consideration but not the most important one for Taiwanese high technology industries businesses. The high technology industry is mainly impacted by economic fluctuations. We conducted further analysis and found that the average number of years that Taiwanese businesses had invested in the high technology industry in China is 8.76 years compared to the 10.72 years for the investments in the non-technology industries. Regardless of the invested locations being in the economic technology development zones, the economic development zones, or the industry zones, the high technology industries invested years are all less than the non-technology industries. In other words, the paid-in capitals of the high technology industry are substantial. The time involved from plant inception, through machinery purchase, installation, and trial run to mass production is longer than for other industries. For the high technology industry, the number of years to achieve profit return is longer, the operating risk is higher, and the required time for the promotion of operating efficiency is considerably longer than that for the non-high technology industries. The averaged invested year is shorter and the payback period is longer rather than others industries. The major production type of the high technology sector is original equipment manufacturer (OEM) in China. Therefore, the margin is relative smaller than upstream value chain of the high technology sector. Furthermore, the local Taiwanese government imposes more restraints on the Taiwanese high technology industries invested in China. Their operating risks are higher than the other industries. Therefore, their operating efficiencies are relatively worse.

For the control variables, like the characteristic impact of company size and sales growth on the company, test we found that as the company size becomes larger, their operating efficiencies worsen. This finding is consistent with works of Dhawan (2001) and Margono and Sharma (2006). The higher productivity or efficiency of smaller firms is the result of their leaner organizational structure that allows them to take strategic actions to exploit emerging market opportunities and to create a niche market position for themselves (Dhawan, 2001). Therefore, the operating efficiency is worse. However, as the company has higher sales growth exhibiting its operating efficiency is better as well as better efficiency performance. This finding is consistent with works of Margono and Sharma (2006).

Finally, we controlled the macro economy to assess its influence on the operating efficiency, with *DYEAR5*, *DYEAR6*, and *DYEAR7* as the control years, and investigated the macro environment factor impacts. Table 4 shows the operating efficiency for the year 2007 deteriorated relative to other years (2004, 2005, and 2006). During the sample periods, starting from 2004 to 2007, the operating efficiency was getting worse by the year.

CONCLUSION

Applying DEA to the operations data for 3,506 firms over the four year period 2004-2007, we find that the economic technology development zone and the economic development zone offer 15% or 24% low tax rate privileges surpassing that offered by the other zones. When the Taiwanese invested businesses are located either in the economic technology development zones or in the economic development zones, their production efficiencies are better. Taiwanese invested high technology industries showed worse operating efficiencies. Although, for the high technology industry, they may enjoy better tax incentives but these benefits are superseded by the greater amount of capital invested and the higher operating risks. Regarding the impact of the company characteristics on operating efficiency, we also find that as the company sizes become larger, their operating efficiencies worsen. The greater capital requirement and the difficulty in achieving economies of scale are the major reasons. However, when the company exhibits higher sales growth its operating efficiency is better as a consequence of its better performance.

Reform in China began in the late 1970s and China has embarked on a path of rapid economic growth (Xu et al., 2006). However, China's dynamic and rapid economic transformation and development, has led to an unbalanced economic structure, regional economic development disparity, and a burgeoning gap between rich and poor. The Chinese government has been trying to modify the industry structure and import/export goods structure. In order to solve the related economic problems, China has continuously ounced and implemented various new economic and trade policies since 2007. For FDI, the new corporate tax laws and policies were implemented on January 1, 2008[5]. This significant regulation change impacted all FDI businesses and increased the tax burdens regarding the business model, investment structure, site selection, and financing strategy.

5 The new corporate tax laws set all the domestic and foreign corporate taxes at 25%. However, for the small businesses and high-and-new technology enterprises 20% and 15% privilege tax rates are applied. The former tax privilege policy of "regional privilege" has turned to "industry privilege". To qualify for the 15% tax benefit, the Chinese government announced "High and New Technology Enterprise Accreditation Rules" on April 14, 2008. The products should be qualified in the "High and New Technology Expertise of National Focus Support". These technologies include: electronic information; biology and new medical engineering; air and aerospace; new materials; high technology service; new energy and energy saving; resource and environmental; and high and new technology remodeling traditional industry. Once the firm has obtained approval in one of the abovementioned eight areas by the authorities and received the high and new technology enterprise certificates, the 15% privilege tax rate would be applied.

After our empirical study, we suggest that the company planning to carry out FDI in China should consider the following matters. There are several advantages of low land, material, and labor costs, and also to the lower tax incentives programs. However, there are some operating risks which need to be treated with caution[6]. From the operation strategy point of view, FDI entity should consider an economic-oriented rather than a political-oriented investment location, and choose to develop core competency for competitive advantage, promote brand recognition, expand the market share, enhance the management skill, resource allocation, and maintain a favorable relationship with the government for an effective operating performance (Sanyal and Guvenli, 2000; Ma and Delios, 2007). China has initiated the market economic mechanism. For FDI, there are several problems of economic structures[7]. Evaluating how the tax incentives affect efficiency would provide an insight for current and potential foreign direct investors into China seeking to improve their operating performance and for policymakers considering foreign direct investment.

Table 1: Descriptive statistics on inputs, outputs, and the other variables

Panel A: By Year *N*=3,506

Variable	Year	Mean	Std Dev	Q1	Median	Q3
Input items						
Paid-in	2004	98577.60	145598.50	29070.00	58017.00	116158.00
Capital (x_1)	2005	136581.85	251950.56	35287.00	72599.50	157243.00
	2006	299531.25	789739.86	59603.00	125000.00	272579.00
	2007	179998.06	234688.80	50014.50	103380.00	221144.00
	2004-2007	183584.44	456531.33	41390.00	90942.50	188254.00
Employee	2004	1277.08	2965.97	280.00	613.00	1300.00
Number (x_2)	2005	1594.80	4857.74	300.00	708.00	1458.00
	2006	2160.04	6192.54	445.00	970.00	2019.00
	2007	2229.10	7332.53	490.00	999.00	2050.00
	2004-2007	1847.40	5703.54	365.00	831.50	1792.00
Output item						
After-tax	2004	21172.47	78440.92	841.00	5617.00	18400.00
Income (y_1)	2005	27903.81	120415.79	1660.00	6930.00	23897.00
	2006	40779.46	164602.03	3211.00	15872.00	39731.00
	2007	49210.05	174126.66	3084.50	15590.50	47017.50
	2004-2007	35698.78	142807.66	1983.00	10152.50	32709.00

6 Some operating risks include: incomplete regulations; unsatisfactory hardware infrastructures (transportation, communications, power supply, and banking service); raw material purchase difficulty/inferior purchase quality; poor market structure; taxation system problems; and financial risks.

7 The problems of economic structures are: unequal industry structure; disparity regional economic development; delayed technology; inferior business quality and competition; population pressure; environmental disorder; severe gap between rich and poor; and bribe and corruption.

Paid-in Capital: paid-in capital of company per year (RMB)

Employee Number: employee number of company per year

After-tax Income: after-tax income of company per year (RMB)

Panel B: By EA vs. NEA

Variable	Economic Zones	Mean	Std Dev	Q1	Median	Q3
Input items						
Paid-in	*EA*	273139.34	502231.43	74655.00	143514.00	311885.00
Capital (x_1)	*NEA*	174805.65	450932.26	41280.00	85485.00	175898.00
Employee	*EA*	1407.08	3315.46	323.00	824.00	1486.00
Number (x_2)	*NEA*	1890.56	5884.29	378.00	832.00	1820.00
Output items						
After-tax	EA	69431.55	209133.79	3905.00	20084.00	65392.00
Income (y_1)	NEA	32392.06	134150.14	1902.00	9699.00	31204.00

EA: economic development zones and economic technology development zones (*N*=313)

NEA: development zones, industry zones and others zones (*N*=3193)

Panel C: By EI vs. NEI

Variable	Electronic Industries	Mean	Std Dev	Q1	Median	Q3
Input items						
Paid-in	*EI*	264648.56	749217.93	61602.00	117548.00	245334.00
Capital (x_1)	*NEI*	158480.91	310865.28	40212.00	81600.00	167651.00
Employee	*EI*	3081.90	10066.49	670.00	1269.00	2980.00
Number (x_2)	*NEI*	1465.10	3261.15	300.00	700.00	1460.00
Output items						
After-tax	*EI*	59266.63	218858.60	2745.00	16230.00	49763.00
Income (y_1)	*NEI*	28400.41	108008.13	1909.00	8985.00	29300.00

EI: high technology industry (*N*=829)

NEI: others industries (*N*=2677)

Table 2: Descriptive statistics of operating efficiencies

Panel A: By Year *N*=3,506

Year	Mean	Std Dev	Q1	Median	Q3
2004	1.8074	0.6063	1.3882	1.6523	2.0264
2005	2.1008	1.0135	1.4549	1.8448	2.4501
2006	2.2236	1.3917	1.6135	2.0659	2.5819
2007	3.3372	5.9322	2.0888	2.6982	3.6869
2004-2007	2.4077	3.3185	1.5474	2.0171	2.7211

operating efficiency ($ln\,\theta$): the efficiency value by BCC model

Panel B: By EA vs. NEA

Economic Zones	Mean	Std Dev	Q1	Median	Q3
EA	2.3826	1.3840	1.5551	2.0806	2.7400
NEA	2.4101	3.4503	1.5474	2.0121	2.7171

EA: economic development zones and economic technology development zones (*N*=313)

NEA: development zones, industry zones and others zones (*N*=3193)

Panel C: By EI vs. NEI

Electronic Industries	Mean	Std Dev	Q1	Median	Q3
EI	2.6833	1.5183	1.7719	2.3622	3.1473
NEI	2.3223	3.6986	1.5000	1.9422	2.5931

EI: high technology industry (*N*=829)

NEI: others industries (*N*=2677)

Table 3: Statistical test results of operating efficiencies

Test methods		*EA* vs. *NEA*	*EI* vs. *NEI*
		Test-statistics (*p*-value)	Test-statistics (*p*-value)
DEA-Based tests	T_{EXP}	1.02 (0.37)	1.57 (0.00)***
	T_{HN}	3.64 (0.00)***	3.00 (0.00)***
Conventional tests	*T*	-0.28 (0.78)	4.06 (0.00)***
	Mann-Whitney	0.63 (0.53)	10.55 (0.00)***
	Kolmogorov-Smirnov	0.90 (0.39)	4.73 (0.00)***

Note: *10% significance；**5% significance；***1% significance

Table 4: Multivariate regression results

$$\ln\theta = \beta_0 + \beta_1 AREA + \beta_2 ELEC + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (4)$$

$$\ln\theta = \beta_0 + \beta_1 AREA + \beta_2 ELEC + \beta_{12} AREA * ELEC + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (5)$$

$$\ln\theta = \beta_0 + \beta_{13} AREA * SIZE + \beta_{14} AREA * GROWTH + \beta_{23} ELEC * SIZE + \beta_{24} ELEC * GROWTH + \beta_3 SIZE + \beta_4 GROWTH + \beta_5 DYEAR5 + \beta_6 DYEAR6 + \beta_7 DYEAR7 + \varepsilon \quad (6)$$

Variables	Coeff.	Predict. Signs	Model (4)		Model (5)		Model (6)	
			Parameter Estimated	*t* value (*p* value)	Parameter Estimated	*t* value (*p* value)	Parameter Estimated	*t* value (*p* value)
Intercept	β_0		-1.3129	-18.46*** (0.00)	-1.3121	-18.44*** (0.00)	-1.3171	-18.23*** (0.00)
AREA	β_1	−	-0.0714	-3.39*** (0.00)	-0.0655	-2.80*** (0.01)		
AREA×SIZE	β_{13}	−					-0.0063	-3.77*** (0.00)
AREA×GROWTH	β_{14}	−					0.0001	1.14 (0.25)
ELEC	β_2	−	0.0363	2.50*** (0.01)	0.0387	2.56*** (0.01)		
ELEC×SIZE	β_{23}	+					0.0032	2.71*** (0.01)
ELEC×GROWTH	β_{24}	−					-0.0002	-2.11** (0.04)
*AREA*ELEC*	β_{12}	−			-0.0306	-0.57 (0.57)		
SIZE	β_3	+	0.1518	26.21*** (0.00)	0.1517	26.17*** (0.00)	0.1523	25.81*** (0.00)
GROWTH	β_4	−	-0.00003	-1.81* (0.07)	-0.00003	-1.79* (0.07)	-0.00002	-1.57 (0.12)
DYEAR5	β_5		0.0784	4.38*** (0.00)	0.0784	4.37*** (0.00)	0.0770	4.30*** (0.00)
DYEAR6	β_6		0.0891	5.26*** (0.00)	0.0891	5.26*** (0.00)	0.0880	5.19*** (0.00)
DYEAR7	β_7		0.3785	22.23*** (0.00)	0.3785	22.23*** (0.00)	0.3763	22.05*** (0.00)
$Adj-R^2$			33.38%		33.37%		33.44%	

F value	251.89(<.0001)	220.41(<.0001)	196.69(<.0001)

Note1: *10% significance；**5% significance；***1% significance

Note2：Definition of Variables:

$ln\theta$: log of the operating inefficiency.

AREA: dummy variable, when the sample location is the economic development zone or the economic technology development zone, the value is 1, otherwise is 0.

ELEC: dummy variable, when the sample industry is high-technology industry, the value is 1, otherwise is 0.

AREA×*ELEC*: the variable of interaction on *AREA* and *ELEC*.

AREA×*SIZE*: the variable of interaction on *AREA* and *SIZE*.

AREA×*GROWTH*: the variable of interaction on *AREA* and *GROWTH*.

ELEC×*SIZE*: the variable of interaction on *ELEC* and *SIZE*.

ELEC×*GROWTH*: the variable of interaction on *ELEC* and *GROWTH*.

SIZE: log of the total asset.

GROWTH: the growth rate of net sales.

DYEAR5: dummy variable, when the sample year 2005, the value is 1, otherwise 0.

DYEAR6: dummy variable, when the sample year 2006, the value is 1, otherwise 0.

DYEAR7: dummy variable, when the sample year 2007, the value is 1, otherwise 0.

The reference section is upon request.

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A Study on the Individual Investors' Sentiment and the Institutional Investors' Recommendation Behavior in Taiwan

Dr. Chuang-Min Chao, National Taipei University of Technology, Taiwan
Yi-Ling Huang, National Taipei University of Technology, Taiwan
wateroceanspring@hotmail.com

ABSTRACT

This study investigate investor sentiment and its relation to stock market returns. We find that many commonly cited indirect measures of sentiment are related to direct measures (surveys) of investor sentiment. However, past market returns are also an important determinant of sentiment. Hence, we review the theoretical and empirical evidence for these predictions and present evidence that investor sentiment actually has strong effects. This study applies OLS regression model to examine the relationship between the abnormal trading volume on weekly of individual investors and the emotional variables. It contributes to the extant literature in several ways. First, by directly comparing between the individual and institutional investors, it provides empirical support for analyst "sentiment" in stock market of Taiwan. Second, it employs a more expansive definition of investors' sentiment to include the trading volume, the dividend premium, closed-end fund discount, and return of stock. Finally, this study finds investors' sentiment can affect the price in stock market of Taiwan.

Keywords: Investors' sentiment; Recommendation; Institutional investors

INTRODUCTION

The history of the stock market is full of events striking enough to earn their own names: the Great Crash of 1929, the Tronics Boom of the early 1960s, the Go-Go Years of the late 1960s, the Nifty Fifty bubble of the early 1970s, and the Black Monday Crash of October 1987. All these events have one thing in common: the dramatic changes in stock price were beyond rational explanation and betrayed the presence of irrational forces causing the fluctuations. One of these forces comes from the intuitive judgments of individual investors on the price trend.

According to classical financial theory, individual investors tend to base their investment decisions on whether the invested target is capable of generating a future return exceeding the amount to be invested. An underlying assumption of the traditional theory, however, is that

investors are believed to be rational; they would, for example, endeavor to reduce systematic risks by diversifying their investment portfolios. Even if some investors are irrational, classical theory argues that their demands will be offset by arbitrageurs and similar conclusions for prices will obtain.

According to the Taiwan Stock Exchange statistics, the proportion of individual investors accounts for 69.4 percent in 2007, indicating that individual investors have a significant influence on the Taiwan stock market. But individual investors usually rely on a large number of various media reports, experts' recommendations, companies' announcement of financial conditions and future prospects. The purpose of this study is to evaluate the individual investors' sentiment (i.e., the psychological factor) and its effect on the Taiwan Stock Exchange Market.

A pioneering and well-known set of Shiller(1981), Fama and French(1988), Poterba and Summers(1988), Campbell and Shiller(1988), and Fama and French(1989) studies of sentiment and aggregate stock returns appeared in the 1980s. They were largely atheoretical, testing in various ways whether the stock market as a whole could be mispriced. We find the role of sentiment was left implicit, and the statistical evidence was not usually very strong. Even when statistical inferences seemed robust, the economic interpretation was still unclear.

Therefore, recently, the more and more studies such as Baker and Wurgler (2006), utilize interim advances in behavioral finance theory to provide sharper tests for the effects of sentiment. In particular, in the many behavioral models of securities markets inspired by De Long et al. (1990), investors are of two types: rational arbitrageurs who are sentiment-free and irrational traders prone to exogenous sentiment. They compete in the market and set prices and expected returns. But, arbitrageurs are limited in various ways.

Now, the question is no longer, as it was a few decades ago, whether investor sentiment affects stock prices, but rather how to measure investor sentiment and quantify its effects.
Moreover, this study is going to examine whether the recommendations made by institutional investors are also affect by emotional factors.

LITERARURE REVIEW

Behavioral Finance

Behavioral finance is the application of psychology to financial decision making and financial markets. It is introduced because an understanding of the psychological factors that

affect investment decision making is relevant for the management of both private wealth and institutional assets. Behavioral finance provides insight into individuals' perceptions and preferences regarding financial risk, and also provide a theoretical basis for investment strategies that attempt to exploit deviations from market efficiency.

Table 1

Traditional financial and behavioral finance comparison

Traditional financial – Efficient Market Hypothesis Harry Robert(1967)；Fama(1970)	Behavioral Finance- Prospect Theory Kahneman and Tverskey(1979)
Investors are rational and they are rational to evaluate the assets of value. The market is efficient.	Investors are limited rational and use the normal behavior to replace rational behavior.
Even though some investors are irrational, because of their trading are random so they eliminate the impact on prices and will not cause deviation of systematic.	Irrational investors are not necessarily transactions occurred randomly.
Some investors have irrational behavior, but arbitrage theory of the market let price recover.	Arbitrage is limited market conditions, so that it cannot exert the function of arbitrage

Shefrin(2000) studies the field of behavioral finance into the heuristic-driven bias, frame dependence and inefficient market. As follows：

1. heuristic-driven bias:

The propensity of investors to make mistakes because they rely on crude rules of thumb rather than optimal statistical procedures. The candidate should be able to evaluate the impact of heuristic-driven biases on investment decision making including representativeness, overconfidence, aversion to ambiguity and etc.

(1) availability heuristic:

Tversky and Kahneman (1973) indicate: for easier access to the message, is easy to overestimate the possibility of its occurrence.

(2) representativeness heuristic:

People often refer to past decision-making known as stereotype. Tversky and Kahneman(1973)point out the representativeness heuristic is a people assume commonality between objects of similar appearance, or between an object and a group it appears to fit into. While often very useful in everyday life, it can also result in neglect of relevant base rates and other errors.

(3) overconfidence:

Individuals in decision-making is always a tendency to overestimate their own discretion and decision-making.The overconfidence effect is a bias in which people are correct in their judgements far less often than they think they are. For example, for certain types of question, answers that people rate as "99% certain" turn out to be wrong 40% of the time. Overconfidence is one kind of what is called the miscalibration of subjective probabilities

(4) hindsight:

Hindsight bias is the inclination to see events that have occurred as more predictable than they in fact were before they took place. In psychological experiments of hindsight bias, subjects also tend to remember their predictions of future events as having been stronger than they actually were, in those cases where those predictions turn out correct.

(5) ambiguity aversion

Ambiguity aversion describes an attitude of preference for known risks over unknown risks. Camerer (1995) think that when people come into contact with the investment of a new financial products or the environment, those who will increase because of uncertainty risk premium

(6) quasi-magical thinking:

Magical thinking (Skinner, 1948) occurs when decisions arise from irrational perceptions of optimization, e.g., choosing lucky or favorite items, numbers and rituals. Tversky and Shafir(1992)finds out personally think that some of his behavior can change the established fact and it explained Self-Deception Effect.

2. frame dependence

whereby investors' decisions reflect not only the underlying fundamentals but how decisions are described. Classified as the following five:

(1) house money effect：

Uncertaintylly, sunk costs and sinking profits have an impact on decision-making, and under certain circumstances, previous profits increase the willingness of individuals to participate in game are called(Thaler and Johnson, 1990).

(2) money illusion:

Personal response for nominal prices large than the price in real terms.Kahneman, Knetsch and Thaler(1986) discover that individuals are concerned about changes in nominal wages rather than changes in real wages. Shafir, Diamond and Tversky (1997) think of personal knows affect of inflation but still measure the their wealth by nominal income.Hence, personal feeling would be affected by nominal income

(3) attribution theory:

In the interpretation of individual behavior (internal attribution) and others to act or environmental factors (external attribution), it will generate error.That error becomes source of bias.Daniel, Hirshleifer, and Subrahmanyam(1998) consider the self-attribution

will become more personal over-confidence.

(4) regret and cognitive dissonance:

Shefrin (2000) finds that the individual in order to avoid regret caused self-blame would tend to maintain this status. And Cognitive bias, people would not face the fact

(5) self-control:

Specifically, refers to the emotional control. When the existence of self-control, investors will avoid loss and realize the stock profits.

3. inefficient market

Meaning mispricing stemming from heuristic driven bias and frame dependence.

Investors' Sentiment and Investors' Index

More recent several studies suggest that investor sentiment and trading activities of noise traders influence stock prices(e.g., Chuang and Lee, 2006) because the smart-money investors trade quickly on the basis of fundamental information in an unbiased manner(e.g., De Long Shleifer, Summers, Waldmann, 1990). Some papers have creatively tried to connect stock prices to exogenous changes in human emotions. For instance, Kamstra, Kramer, and Levi (2003) find that market returns are on average lower through the fall and winter, which they attribute to the onset of seasonal affective disorder, a depressive disorder associated with declining hours of daylight. However Petty, Gleicher and Baker(1991) find out the bad feelings would be to investor comparison of information analysis carefully and critical assessment. Wright and Bower(1992) also find the investor do optimistic judgments and decision-making when they are in a good mood state than in a worse mood state.

Therefore, the inexperienced individual investor is more likely than the professional to be subject to sentiment. Barber, Odean, and Zhu (2003) and Kumar and Lee (2006) find in micro-level trading data that individual investors buy and sell stocks in concert, which is consistent with systematic sentiment. Moreover, a growing literature presents evidence of irrational behavior of individual investors in option markets. Options prices rise when the value of the underlying asset has greater expected volatility, and options pricing models such as the Black-Scholes formula can be inverted to yield implied volatility as a function of options prices. Poteshman (2001) shows that option market investors exhibit the same pattern of shortterm underreaction and long-term overreaction to information that has been found in stock markets. Han (2008) finds that investor sentiment about the stock market affects option prices.

On the other hand, Qiu and Welch (2006) and Lemmon and Portniaguina (2006) show that

changes in the consumer confidence measure correlate especially strongly with small stock returns and the returns of firms held disproportionately by individual investors. Chen Ing Lee (2004) and Wei Liang Chang (2006) also point out that Consumer Confidence Index nonetheless correlate highly with changes and predictive capability in stock market of Taiwan. Trading volume, or more generally liquidity, hence, can be viewed as an investor sentiment index. For instance, Baker and Stein (2004) note that if short-selling is costlier than opening and closing long positions, irrational investors are more likely to trade, and thus add liquidity, when they are optimistic and betting on rising stocks rather than when they are pessimistic and betting on falling stocks.

Indeed, many experts use of Dividend premium, Closed-end Fund Discount, Option implied volatility, Equity issues over total new issues, IPO first-day returns, IPO volume and Insider trading etc to measure the emotion of investors. However, Investor sentiment is not straight forward to measure, but there is no fundamental reason why one cannot find imperfect proxies that remain useful over time. At present, there is no unity in the academic definition of investor sentiment. It is usually represent the future of the investment market or an indicator of optimism or pessimism. Hence, this paper discuss some generic issues involved in measuring sentiment and describe proxies for sentiment in Taiwan .

METHODOLOGY

Sample and data sources

The sample companies in this study are the stocks listed in the Taiwan 50 index which contains the Top 50 highest trading volume stocks in Taiwan stock market and listed in the Taiwan Mid Cap 100 which contains the between 51 and 150 trading volume stocks in Taiwan stock market. The data used in this study is observed from 2007 to 2008. We use IBES database which the original recommendation types are categorized as five grades (1 = Strong Buy, 2 = Buy, 3 = Hold, 4 = Underperform, 5 = Sell). This study regroups the data and divides them into three types, namely, neutral, buy, and sell. The contribution of this study is to provide more evidence of the emotional impact on the individual investors as well as the institutional investors.

Table 2

Classification sheet in Stock of foreign capital

Neutral	Experts' Buy Recommendations	Experts' Sell Recommendations
hold	Strong Buy	Sell
market perform	Attractive	underperform
inline	Outperform	
inline with stock	Overweight	

The model

This study applies OLS regression model to examine the relationship between the abnormal trading volume on weekly of individual investors and the emotional variables. Moreover, the multinomial logit model is used to examine the relationship between the emotional variables and the ratings reported by the institutional investors. The emotional variables (or the sentiment indicators) used in this study are the trading volume, the dividend premium, closed-end fund discount, and return of stock.

SUMMARY AND CONCLUSIONS

Then the results will be compared and contrast between the individual and institutional investors and see whether they are affected by the similar underlying emotional factors.

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Market Reaction to Rating Report by Foreign Institutions: A Price and Trading Behavior Analysis

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Hung-Yu Chen, National Taipei University of Technology, Taiwan
dora_rainbow@msn.com

ABSTRACT

The purpose of this study is to investigate the security returns and trading behavior of institutional investors and individual investors in Taiwan stock market around the rating report announcement of foreign institutions. The data used in this study is observed from Jan, 2007 to Oct, 2008. The sample companies in this study are the stocks listed in the TSEC Taiwan 50 Index *which contains the Top 50 high trading volume stocks in Taiwan stock market. The event study method is used, while the market model is used to estimate the expected value of the price, trading volume and transaction numbers. The abnormal returns, abnormal trading volume and the abnormal transactions numbers are therefore calculated and used to examine whether the announcement of the rating report will lead to an abnormal trading behavior of the investors in Taiwan stock markets.*

From this study, we investigate the effect of rating report by foreign institution on different types of investors based on the stock price, trading volume and transaction numbers. That results help researcher to understand the information effect on investors and the duration of the effects under the bear and bull market period. In addition, understanding the different trading behavior of investors helps investors to make better decisions when receiving information.

Keywords: Trading behavior; Event study; Information content

INTRODUCTION

Examining the reaction of financial markets to various micro and macro events has been the subjects of numerous studies. Previous researches (Liu, Smith and Syed, 1990; Foster and Viswanathan, 1988) have noted that stock price and trading volume would be affected by the market information. The purpose of this study is to investigate the security returns and trading behavior of institutional investors and individual investors in Taiwan stock market around the rating report announcement of foreign institutions. In the next section, I review theory relating information value, including the impact of the information and the effect

duration. The third section describes the research design, while the fourth section presents the empirical results. Overall conclusions are discussed in the final section.

LITERATURE REVIEW

In an efficient market, security prices at any given time fully reflect all available information. Previous research documents price reaction to all kind of information in different financial markets. Glascock, Henderson and Martin (1986) find a significant positive price reaction for securities added to E. F. Hutton's "buy" list. Lloyd-Davies and Canes (1978), Syed, Liu and Smith (1989,1990, 1992) report significant positive abnormal stock price responses to the publication of analyst recommendations in The Wall Street Journal 's "Heard on the Street" (HOTS) column . Beaver (1968) introduced trading volume as a means of measuring the degree of consensus among investors with respect to a given information disclosure. He found that trading volume increases significantly at annual preliminary announcement dates, implying that there may be a lack of consensus across market participants in interpreting earnings data. Many recent studies have found that increased trading volume was associated with the release of information. For example, Karpoff (1986) develop a theoretical model to provide a rationale for the use of trading volume in event studies that attempt to identify the information content of an event. Beaver (1968), Bamber(1986) reported that trading volume increased significantly around that trading volumes of targets of tender offers increased significantly during the weeks preceding the announcement of the bid. Lakonishok and Vermaelen(1986) examined trading volume around ex-dividend days and reported that trading volume increased significantly around ex-dividend day.

This study also use "number of transactions" as an information content metric, recent studies by Howard (1982) and Cready (1988) also use number of transactions to measure trading behavior. The transaction numbers was the sum up of each trade, that means each trader was equally and Cready and Ramanan (1990) find that statistical tests employing number of transactions appear to be considerably more powerful than tests employing trading volume in measuring unexpected trading activity.

On the other hand, all kinds of information may cause different investors have different trading behaviors. Because investors may have different trading behaviors due to national customs and habits or the quality, quantity and speed in capturing information, or the differences in information recognition. Hakansson(1977)indicates institutional investors with more resources are better able to interpret complex information. Wu and Lee(2005)explore when the market-wide information declared whether the reactions of different kinds of

investors are consistent. It indicate institutional trading volume respond more sensitively than individual trading volumes in bull market when either good news or bad news is announcement. However, the result is contrary in bear market. Lee, Wu and Wang(2006) finding that domestic investors tend to sell, while the foreign investors tend to buy as good news is announced in the bull market. While domestic investors incline to buy, and the foreign investors incline to sell when bad news is announced either in the bull or in the bear market.

METHODOLOGY

Data

All stocks on the TSEC Taiwan 50 Index during the period 2007-2008 are potential candidates for this study. To be retained in the final sample, the company must have available (1) an rating report announcement by foreign institution (2) non-missing interday trading data on announcement date. All the data were obtained from the TEJ data bank. In cases where we found more than one announcement date for the rating reports, we used the announcement that at least 20 days duration. We then divide our sample into three groups based on different market periods: bull market, neutral market and bear market. Table 1 provides a description of the composition of the final sample.

TABLE 1 Description of the Final Sample

Bull market	Bear Market	Neutral Market	Total
16	29	57	102

Research Design

The research design consists of two stages. The first stage examines the price response to the rating report using abnormal returns at rating report release dates. The second stage using abnormal trading volume and abnormal transactions numbers to examine the trading response to the rating report.

The methodology adopted here is the standard event analysis. First, to estimate the market model for each stock and, then, to compute abnormal returns ,abnormal trading volume and the abnormal transaction numbers associated with each rating report announcement . The abnormal return is the difference between actual and predicted stock returns during a specific time period around the announcement day. The actual return for stock i on day t is given by

$$R_{i,t} = a_i + B_i \times R_{m,t} + e_{i,t}$$

where $R_{m,t}$ is the return on a market portfolio (market index) for day t .The parameter estimates a_i and B_i are obtained by using all available data for trading days -70 to -11 relative to the event date and $e_{i,t}$ is a stochastic error terms. The abnormal returns are computed as follows:

$$AR_{i,t} = R_{i,t} - (a_i + B_i \times R_{m,t})$$

where $(a_i + B_i \times R_{m,t})$ is the predicted stock return base on 60 day estimated period and $R_{i,t}$ is the actual return of stock i on day t. If the market is efficient, security prices should reflect all potential changes in the event outcomes. That is, if the required rate of return on a stock around the event day is identical to that of any other random trading day, one should not be able to make excess returns by trading around all of these event days.

The second stage also use event analysis to compute the abnormal trading volume and abnormal transaction numbers. The actual trading volume for stock i on day t is given by

$$V_{i,t} = a_i + B_i \times V_{m,t} + e_{i,t}$$

Where $V_{m,t}$ is the trading volume on a market portfolio (market index) for day t .The parameter estimates a_i and B_i are obtained by using all available data for trading days -70 to -11 relative to the event date and $e_{i,t}$ is a stochastic error terms. The abnormal trading volume are computed as follows:

$$AV_{i,t} = V_{i,t} - (a_i + B_i \times V_{m,t})$$

$(a_i + B_i \times V_{m,t})$ is the predicted stock trading volume base on 60 day estimated period and $V_{i,t}$ is the actual trading volume of the stock i on day t.

Finally, to compute the abnormal transaction numbers. The actual transaction numbers for stock i on day t is given by

$$TR_{it} = a_t + B_i \times TR_{m,t} + e_{it}$$

where $TR_{m,t}$ is the transaction number on a market portfolio (market index) for day t .The

parameter estimates a_i and B_i are obtained by using all available data for trading days -70 to -11 relative to the event date and $e_{i,t}$ is a stochastic error terms. The abnormal transaction numbers are computed as follows:

$$ATR_{i,t} = TR_{i,t} - (a_i + B_i \times TR_{m,t})$$

$(a_i + B_i \times TR_{m,t})$ is the predicted stock transaction numbers base on 60 day estimated period and $TR_{i,t}$ is the actual trading volume of the stock I on day t.

EMPIRICAL RESULTS

Table 2 shows the market reactions from days -3to +3.We find out a significant increase in abnormal return, abnormal trading volume and abnormal transaction numbers on the day before publication date (day -1).The results are consistent with previous studies (Syed, Liu and Smith,1990;Robert and Timothy,1996)that investigate the trading volume and returns reaction to the release of information. It seems that information has been leaked to the market prior to publication. The abnormal return on day t = -1 maybe due to the advance trading based upon speculation or knowledge about the forthcoming rating information .The average abnormal return on announcement day is 2.27 percent(t-value=1.92).Investors can not get abnormal returns on the day after announcement date. The abnormal trading volume has similar results to abnormal return. It appears that the publication of the rating report cause trading volume to increase on the publication date. It's interesting that the abnormal transaction numbers surrounding the announcements is significantly positive from the day -1 to the day 1.On possible explanation is these translations are come from the individual investors. Because individual investors may trade in very small amount due to these sample stocks are relative expensive. That's why it doesn't has the abnormal trading volume but still has the abnormal transaction numbers in the day = 2.Overall, Taiwan stock market seems very effective to reflect the new coming information. The market work effective may due to the following reasons. First, the sample stocks in our study are the TSEC Taiwan 50 Index stock, which are 50 of the most highly capitalized blue chip stocks and represents nearly 70% of the Taiwanese market. Because of the high fame, investors are relative know and understand these stocks so they have better ability to determine the authenticity of information.

TABLE 2 Market Reactions to the Rating Report by Foreign Institution (Total Sample)

Event Day	Abnormal Return		Abnormal Trading Volume		Abnormal Transactions numbers	
	AR	t-Value	AV	t-Value	ATR	t-Value
-3	0.002	.020	0.052591	1.604316	0.044072	.678
-2	-0.0347	-.293	0.019744	0.783795	-0.027906	-.403
-1	0.2278	1.801**	0.052824	1.70694**	0.117949	1.777**
0	0.2273	1.920**	0.090645	2.169974*	0.228808	2.149*
1	-0.0397	-.365	0.041241	1.536048	0.103594	1.781**
2	0.0877	.710	0.035952	1.295164	0.078197	1.276
3	0.0763	.628	0.046004	1.626503	0.008171	.185

Next, we take the different market period into consideration. Table 3 shows market reactions to rating reports in different market periods, we find out a interesting result that is market significant response to these rating reports in the neutral period. The possible explanation for this result may be the transactions are come from the individual investors. In the market condition not bright and clear, individual investors need more information and advices from the experts to guide them how to invest and then to adjust their stocks on hand. That's why after the rating report by foreign institutions release we can find a very long duration of significant increase in abnormal transaction numbers in neutral market period.The reason that rating report doesn't have influence on the bull or the bear market maybe also due to the sample characteristics. We can conclude that these sample stocks all the leading company in the industries so they seems become a good choice for investors to hold in the bear market .That maybe the reason we find the abnormal trading volume before the announcement date but could not find any abnormal trading behaviors after the release of rating report. On the other hand, in the bull market when the investors are very optimistic to the market trend, investors may like to invest their money on small scale stock that relatively more potential instead of these blue chips stock. Consistent with the result of Wu and Lee(2005), theyindicate that the return of portfolios with large volumes do not respond more heavily than with small volume despite good or bad news in the bull market.

TABLE 3 Market Reactions to the Rating Report by Foreign Institution

	Bull market			Neutral market			Bear market		
Event day	AR	AV	ATR	AR	AV	ATR	AR	AV	ATR
-3	0.079401	0.079401	0.156387	0.085774	0.047177	0.038506	-0.06858	0.048439	-0.006956
-2	0.01839	0.01839	-0.10297	-0.12245	0.024598	0.076587	0.174038	0.010949	-0.191872*
-1	0.015947	0.015947	0.103079	0.376009*	0.059062	0.189533**	0.094379	0.060909**	-0.014548
0	0.139243	0.139243	0.259075	0.384663*	0.090118	0.336136**	-0.08143	0.064869	0.001156
1	-0.06536	-0.06536	-0.1145	0.122247	0.054461	0.212502*	-0.34067	0.075242	0.006513
2	-0.08314	-0.08314*	-0.2186**	0.09177	0.055196	0.186855*	0.032534	0.065899	0.024692
3	0.003093	0.003093	-0.08908	-0.11827	0.028108	0.024976	0.437379	0.109214**	0.030321

CONCLUSION

This paper examines intraday trading activity on the TSEC Taiwan 50 Index surrounding the rating report announcements to address the following questions: (1) do these data provide information to investors; and (2) does different kinds of investor affect the usefulness of the information and the speed by which the information is processed.
Abnormal trading behavior including the abnormal trading volume and abnormal transaction numbers suggest that rating report announcements are informative to investors.
This study examines the information contained in rating report announcements and we extend previous research in this area by employing intraday trading data, which allows us to assess the relative informativeness of the rating report announcements across different classes of investors.

We find that abnormal returns could be generated by trading on the day before and the day rating report it is released. Consistent with previous studies, we also find information has leak in advance so that the abnormal trading volume and abnormal transaction all occurring earlier than the announcement day of the rating report. We also find the effects of rating report on abnormal transaction numbers are last longer than abnormal trading volume. However, investors only to trade on the announcement and the day before announcement can get abnormal return..

Overall, there are all kinds of information flow in the stock market and some can simulate investors to have abnormal trading behaviors but investors may not always get the abnormal return. Besides the help of new technology such as internet to accelerated the speed of transfer information, investors in Taiwan sock market over a long period of time to learn and

accumulate the experiences, no debut the Taiwan stock market is work more effective now.

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THE INFLUENCING FACTORS OF SUPPLIER'S SPECIFICITY INVESTMENTS

Ya-Jung Wu, Kao Yuan University, Taiwan
yajungwu@yahoo.com.tw

Hong-Chun Wang, National Cheng Kung University, Taiwan
r4892103@ccmail.ncku.edu.tw

ABSTRACT

This article is intended to detect the powerful factors which influence the suppliers' decisions in partnerships with their customers. Although over the past two decades, the formation of international and inter-firm collaborations has increased substantially, especially in the context of buyer-supplier relationships, empirical validations on the question of when do suppliers risk making specificity investments are limited. Thus, the primary purpose of this study is to go one step further and empirically verify the inter-relationships among strategic drivers, partnership governance mechanisms, relational factors, and supplier's specificity investments.

This model is empirically tested in the context of purchasing relationships between foreign buyers and Taiwan exporting oriented manufactures. Based on the results of this study, several conclusions can be drawn. The first conclusion is that there are significant relationships between relationship characteristics and specificity investments. In addition, there are significant relationships between supplier 's strategic drivers and specificity investments. Concerning the relationship between buyer's SD strategies and specificity investments, the positive influence of supplier incentive on specificity investments is significant. In addition, it was also found that a higher level of competition pressure is significantly positively associated with the level of supplier's specificity investments.

Keywords: Specificity Investments, SD strategies, Strategic Drivers, Relationship Characteristics

INTRODUCTION

This article is intended to detect the powerful factors which influence the suppliers' decisions in partnerships with their customers. Although over the past two decades, the formation of international and interfirm collaborations has increased substantially, especially in the context of buyer-supplier relationships, empirical validations on the question of when do suppliers risk making specificity investments are limited. Thus, the primary purpose of this study is to go one step further and empirically verify the inter-relationships among strategic drivers, partnership governance mechanisms, relational factors, and supplier's specificity investments. By reviewing the literature on buyer-supplier partnership from the fields of industrial marketing, organization theory, strategy, and transaction cost economics, we offer a preliminary examination of following issues.

Firstly, traditionally, through the viewpoint of transaction cost analysis, assets specificity is viewed as a risk should be taken into consideration in governance mode design. However, this study would like to adopt the transaction value perspective to explore whether attenuating uncertainty and seizing the leaning opportunities drawing from supplier's investment in asset

specificity will lead to suppliers risk making specificity investments.

Secondly, in contrast with transaction cost analysis, in which supplier 's specific assets investment is seen as an independent variable to choose an appropriate governance mode in terms of outsourcing or internalization, this study would like to build a full model concerning whether to involve in a highly specific asset investment under a given partnership from a supplier perspective. Thus, supplier 's specific asset investment is seen as a dependent variable in this study, and the influences from relationship characteristics as well as buyer 's deployment on supplier development strategies are included as independent variables. Resource dependence theory, cognition evaluation theory and relation exchange theory are adopted to examine to what extent do different supplier development strategies as well as different relationship characteristics impact on supplier's specific asset investment.

Finally, a comprehensive model discussing supplier's specificity investments in the context of buyer-supplier partnership will be built and empirically tested. Combing multiple theories in the field of interorganizational research, this study aims at building a model in global value chain to integrate supplier's strategic drivers, buyer's governance mechanisms, as well as relational factors to explain when do suppliers risk making specificity investments. This model will be empirically tested in the context of purchasing relationships between foreign buyers and Taiwan exporting oriented manufactures.

LITERATURE REVIEW

Asset specificity

The extent to which one partner's assets are specialized to the other is viewed as key in determining exchange cost. The distinguishing feature of transaction specific assets is that their value would be largely lost if the focal relationship were terminated (Williamson, 1985). Williamson (1985) suggested that idiosyncratic investments stabilize relationships by altering the firm's own incentive structure. By making idiosyncratic investments in a relationship, a channel member creates an incentive to maintain the relationship. Because idiosyncratic investments are essential to certain channel relationships, they are difficult or impossible to redeploy to another channel relationship. Specific asset investment may take a variety of forms. Some examples of idiosyncratic investments in Buyer-supplier relationships are training or dedicating personnel to servicing a specific manufacturer's products, adopting a common order processing system, building specialized facilities to handle a specific manufacturer's product line. In addition, they include a company's set-up of immobile production units near the site of a partner to economize on transportation costs ("site specificity"). They also include mobile resources ("physical asset specificity") and know-how ("human asset specificity"), or investments in generalized production capacity that have been solely make for the purpose of serving the partner (dedicated assets").

Such investments are a necessary part of achieving strategic outcomes because they promise efficiencies in coordination (Williamson, 1984) and have several important relationship-stabilizing properties. They facilitate expectations of continued exchange into the future (Heide & John, 1990) and represent credible commitments to the relationship that are useful in minimizing opportunistic behavior (Anderson & Weitz, 1992; Williamson, 1985).

While recent empirical evidence suggests that investments in these assets can improve

productivity, the decision to invest in specific assets also carries a certain cost (Dyer, 1996). Because to their specificity, investments in relationships cannot be easily transferred to another use and thus limit the investor's flexibility. According to Sollner (1999), inflexibility is a troublesome source of at least three risks that result from entering a close relationship, including: (1) risk of misinterpreting the client's "benefits sought": the risk refers that if a supplier practices relationship selling, but the client does not practice relationship buying, substantial investments may be wasted. (2) risks of imitation and substitution: the risks refer that if the client considers a close relationship to be a beneficial organizational arrangement, competitors might respond. While imitation will increase the supply, substitution will reduce the demand. These responses can become a genuine threat to the original supplier. (3) risk of hold-up: it refers cases in which one party takes advantage of a situation in which the other party can be forced to renegotiate a contract. Thus, if only the supplier makes significant investments, an exploitation hazard exists, and the buyer has the opportunity to extract the supplier 's anticipated surplus.

Relational Factors: Power and Norms

Transaction cost theory has achieved a prominent role in the analysis of governance mechanisms for exchange relationships. However, the assumption of opportunism that underpins this perspective has been challenged. Specifically, in the marketing literature, Hide and John (1992) argue that norms play a central role in structuring relationships between firms and have produced empirical evidence to support this contention. In contrast, Stern and El-Ansary (1992) argue that power is the major means available to achieve coordination and cooperation among channel members. Similarly, in the channel context with asymmetrical power structure between small buyer and big supplier, Berthon et al. (2003) find that norms do not play a significant role. They suggest that mechanisms other than norms are at work, such as power and interdependence. Thus, in this study norms and power are seen as two different kinds of governance mechanisms employed by OEMs under specific network relationship. It is argued that based on these governance mechanisms, an interaction platform of Buyer-supplier relationship is building. To the extent of opportunistic expropriation of suppliers affects their behavior before engaging in follow-up relationships. From the suppliers' perspective observable relationships reflect choices of partners maximizing the expected return on investments in specific assets. Thus, norms and power are seen as two critical context factors influencing supplier's specific asset investment, relationship learning, as well as supplier 's upgrading.

Norms in exchange relationships

Vertical control has been suggested as a functional substitute for ownership in nonintegrated situations, although there is limited understanding of the conditions that enable a firm to establish vertical control in relationships between independent firms (Heide and John, 1992). Heide and John (1992) propose that the presence of certain strong relational norms represents such a condition. Pfeffer and Salancik (1978) mention that norms are commonly of or widely shared sets of behavioral expectations. In other words, a norm is a belief shared to some extent by members of a social unit as to what conduct ought to be in particular situations or circumstances. They argue that norms, which have evolved to coordinate interorganizational behavior, are general in content and apply to issues of trust and predictability. Similarly, Dwyer et al. (1987) in their discussion of the development of expectations between trade parties focused on the concept of trust as one major issue deserving priority, since relational

exchange dominates over discrete transactions. According to Kaufman and Stern (1988), three factors play a most important role in developing attitudinal ties between partners, namely solidarity, role integrity, and mutuality. The norm of solidarity in relational exchange makes the parties seek to maintain and preserve a unique and continuing relationship. Very often the parties develop a strong reputation of trustworthiness and view the particular relationship as important in itself. The focus of the relational norm of role integrity is on the enactment of roles that reflect the parties' promises and expectations. Typically, the parties to a close business relationship enact highly complex roles that reach far beyond the mere exchange of goods. The relational norm of mutuality focuses on the fair distribution of the benefits derived from the relationship as a whole. Keeping in mind the specific context in which this research was conducted-relationships between Buyers-suppliers in the electronic equipment manufacturing industry—flexibility, information exchange, and solidarity (cf. Heide and John, 1992) were deemed to be the relevant relational norm dimensions.

Flexibility refers to the expectation that the appropriate behavior when one of the partners is facing an unanticipated crises is for the other partner to be willing to renegotiate the original terms of the contract to take into account the changes in the contractual environment. Information exchange refers to the expectation that the appropriate behavior for both exchange partners is to communicate frequently, informally, and with full disclosure. Finally, solidarity is the expectation that it is appropriate for exchange partners to work in the best interest of the relationship and that it is inappropriate for them to make moves that secure only unilateral gains (Gundlach, Achrol, and Mentzer, 1995; Heide and John, 1992).

It is found that in high relational norm relationships exchange parties are more committed (Gundlach, Achrol, and Mentzer, 1995) and demonstrate a long-term orientation (Ganesan, 1994) because they are confident that their actions will not be opportunistically abused (Heide and John, 1992). By providing a generalized safeguard against partner opportunism, relational norms make parties more willing to engage in actions that result in relationship continuity. In addition, in a context of asymmetrical commitment in business relationships, Sollner (1999) finds that in the traditional transaction cost framework, the expectation that asymmetrical instrumental inputs in a relationship will have a negative effect on relationship justice as perceived by the supplier (if the supplier has made higher investments) is unconfirmed. Further, it is also found that the buyer's attitudinal inputs have a strong impact on the supplier 's perceived justice if the supplier is "locked-in". On the other hand, in the absence of attitudinal inputs of the buyer (relationship norms), perceived justice of the supplier would be lower. In line with Heide and John (1992), he indicates that relationship norms provided by OEMs not only do serve as a safeguard against opportunistic behavior, but are an important ingredient in all close and long-term business relationships. Thus, it seems that suppliers do not thoughtlessly enter business relationships to get trapped and exploited. Consequently, in high relational norm relationships, expectation of relational continuity is high, which in turn reduces supplier 's perceived risk of hold-up concerning specific asset investment. Thus, we propose that,

Hypothesis 1: In a buyer dominated network, the greater extent of norms between buyer-supplier relationship, the more likely that the supplier will have a positive effect on the willing to invest in idiosyncratic assets.

Dependence structure

According to the social exchange and resource dependence ideas of Pfeffer and Salancik (1978), Provan, Beyer, and Kruytbosch (1980), and others, dependence is critical for understanding interorganizational relationships. Gundlach and Cadotte (1994) define a dependence structure as consisting of two dimensions: the degree of interdependence between parties and the relative balance of power within the relationship. The term, asymmetric dependence, is used to indicate that the dependencies of the two parties are such that one party holds a power advantage over the other. In contrast, equilibrium can exist at any level of interdependence, but the relative balance of power must be equal for an equilibrium state to exist. Following this concept, the variables of central interest in this study are the two dimensions of the transacting parties' dependence structure: interdependence and power asymmetry.

Customer's power advantage. Dahl (1957) defined power as the ability of one individual or group to get another unit to do something. El-Ansary & Stern (1972) applied this concept to distribution channels by defining power as the ability of a channel member to control the decision variables in the marketing strategy of another member at a different level in the channel of distribution. In this study, customer's power advantage refers to the degree of power asymmetry as represented by the extent to which the supplier 's dependence on its OEM customer exceeds the customer 's dependence on this supplier.

Both transaction cost analysis and resource-dependence theory suggest that uneven rewards from exchange relationships will result if either party has an advantage over the other party. Drawing on resource-dependence theorist have proposed hat dependence of actor A on actor B will lead to poor outcomes for A if A's dependence exceeds actor B's dependence on actor A. The reason is that the advantaged firm is able to use its power to achieve its own objectives at the expense of the weaker party as has been discovered in bargaining situations (Pfeffer and Salancik, 1978). In the context of Buyer-supplier relationship, Hakansson (1982) observes that powerful OEMs are able to leverage their position to demand adjustments to agreements without offering compensation. Kalwani and Narayandas' (1995) study of suppliers in the industries where they are usually the weaker party reports that "firms in long-term relationships face lower gross margins over time". The reason is that a customer with a power advantage can demand price concessions and shorter production runs with success because alternative suppliers are available and the disadvantaged supplier has few options other than adjusting. Such demands can severely affect the performance of component suppliers since a single OEM's business often accounts for a sizable share of a supplier 's revenue. Thus, as customers with power advantages are expected to be able to make costly demands on their weaker supplies and receive compliance to these demands. Under this circumstance, should suppliers build close partnership with OEMs through specific asset investment?

There are two different perspectives concerning how the relatively dependent party copes with demands from their more powerful partner. One perspective suggests that relatively dependent suppliers will comply with OEM demands as they want the relationship to continue and hence have no choice but to comply (Provan and Skinner, 1989; Williamson, 1985). The resistance perspective, on the other hand, suggests that the relatively dependent party will actively seek to block OEM demands through countermeasures (Lawler, Ford and Blegen, 1988). We discuss these two perspectives as followings:

The Compliance Perspective. It is argued that suppliers who are dependent on their OEMs are expected to comply more readily with OEM requests. Support for a positive relationship between dependence and compliance derives from a number of different theoretical sources. Firstly, Frazier & Rody (1991) and Scheer & Stern (1992) found that inter-firm power can play a positive role in promoting the effective coordination of channel relationships for both the relatively powerful and the relatively dependent channel member. They argue that more powerful parties may recognize the benefits of strong partner relationships and use non-coercive influence strategies to effect cooperation and joint outcomes. Consequently, the weaker suppliers could put their worry aside this partnership. Further, according to social exchange theory (Dwyer, Schurr, and Oh, 1987; Hallen, johanson, and Seyed-Mohamed, 1991), parties choose to become dependent on their partners when they conclude that the benefits resulting from these investments will outweigh the costs of increased vulnerability.

Although this specific asset investment would enhance supplier's dependence level on OEM, if it could build a leaning platform for competence upgrading or bring more business opportunities, it is worth taking risk. Since, it is established support for a positive relationship between dependence and compliance (see Anderson and Robertson, 1995; Keith, Jackson, and Crosby, 1990), we propose that,

Hypothesis 2: In a buyer dominated network, the greater the power advantage of a customer, the weaker bargaining power of the supplier will be in the network, and hence, the more likely it is that the supplier has to invest in specific assets under the customer's pressure.

The Resistance Perspective. Asymmetric interdependence in exchange relationships creates power imbalance. Supplier relative dependence on a OEM translates into OEM power over the supplier. In other words, it results in enhanced ability by the OEM to control supplier behavior. This is likely to create feelings of animosity, resistance, or revenge that motivate the other to be uncooperative, feud, or retaliate in ways that undermine the relationship. Similar logic led Anderson and Weitz (1989) to suggest that asymmetric power relationships are less stable, due to lower trust and confidence in the future. In addition, as a consequence of increasing OEM power, it is expected that relatively dependent supplier will perceive a greater threat to their freedom of action than will suppliers who are not relatively dependent on their OEMs. According to Reactance Theory (Brehm, 1966), as the perceived threat of constraints on free behaviors increase, the magnitude of reactance behaviors (that is, behaviors intended to undermine these constraints), also increases. Given their relative dependence, manufacturers may have to frequently sacrifice their self-interest in being required to behave in ways that meet the demands of their more powerful OEM. As the constraints on manufacturer self-interest enhancement behaviors increase, it is expected that these suppliers will react to undermine these constraints. Consequently, the supplier will not support specific asset investment.

Hypothesis 3: In a buyer dominated network, the greater the power advantage of a customer, the more unlikely it is that the supplier will invest in specific assets under the customer's pressure.

Interdependence refers to the level of mutual supplier and customer dependence in the relationship. As evident by these definitions, the dependence structure of an exchange relationship is derived fundamentally from each firm's level of dependence on the relationship. For suppliers and customers, a firm's own dependence is determined by the

availability of substitutes and he firm's need for the resources derived from exchanges with the other company.

In contrast to asymmetric dependence, interdependence is expected to have positive consequences for exchange relationships. Firstly, according to bilateral deterrence theory (Bacharach and Lawler, 1981) and social exchange theory's norm of reciprocation contend that, all else being equal, greater interdependence leads to lower conflict, greater cooperation, and greater trust as retaliation poses an ever-greater threat for both partners (Kumar, Scheer, and Steenkamp, 1995). It is expected that interdependence serves to raise the "costs" of acting unilaterally and using coercive influence and provides an effective deterrent to self-serving behavior (Anderson and Weitz, 1992), since dyadic relationships are often embedded in a broader network of supplier-buyer relations, a view strongly expressed by Granovetter (1985) who maintains that such social embeddedness provides a powerful incentive to limit opportunistic acts.

In addition, as argued by Provan (1993) and in consistence with Axelrod's (1984) ideas on cooperation, when outcome interdependence is high, interdependent firms will not necessarily seek short-term goals, but rather look for long-term strategic advantage. The reason is that interdependence discourages OEMs from using their power to demand exchange concessions because such requests will meet resistance and may produce conflict, supply interruptions and product quality lapses. Further, interdependence also provides a mutual incentive for suppliers and OEMs to cooperate. Such cooperation is essential since many aspects of the final product's performance do not fall exclusively within a single member 's domain but rather involve complex systems that draw upon both partners' unique competencies. Many of the recent trends in original equipment manufacturing are motivated by the potential to increase final product performance through such systematic cooperation (e.g., Just-in-Time, supplier involvement in product development, etc.). Under this close partnership, the customer has a strong incentive to maintain the relationship and avoid disruptive disagreements over pricing and other sensitive issues. In other words, goal incongruence does not exist in this close partnership. Hence, when outcome interdependence is high, as in well-established networks, member firms can be expected to make some short-term sacrifices that do not necessarily serve their immediate interests in return for expected long-term strategic advantage.

Thus, when a buyer is highly dependent on a supplier, its own opportunistic acts toward the supplier are likely to have little long-term advantage. Hence, high inter-dependence reflects an increased willingness to cooperate with the primary buyer in ways that are likely to benefit both organizations in the long-run.

Hypothesis 4: In a buyer dominated network, the greater the inter-dependence between OEM and the supplier, the more embedded the relationship will reduce the buyer's opportunisms in the network, and hence, the more likely it is that the supplier will invest in specific assets.

The Strategic Drivers for Suppliers

The final set of hypotheses addresses the contextual conditions that influence the willing of supplier-specific investments. These components include environmental dynamism, learning intent, and customer technical innovativeness.

Environment dynamism

Uncertainty creates information problems in exchange. External uncertainty caused by market dynamism makes it more difficult to predict future contingencies. Another kind of uncertainty comes from technological unpredictability. Given that the setting of this study is supply markets, we define market dynamism as the degree of variability in a firm's supply market (Achol, Reve, and Stern, 1983; Cannon, et al. 2000); and technological uncertainty is defined as the extent of inability to predict accurately the technological changes in the product purchased and its underlying manufacturing processes (Stump and Heide, 1996).

Market Dynamism When suppliers perceive a dynamic, uncertain environment and rising demand for the dyad's outputs, they are more willing to expend the effort to exploit the distinctive aspects of their relationship and coordinate across the dyad. Jap (1999) indicate that it may be that environmental uncertainty motivates suppliers to form close relationships with buyers because it enables the suppliers to obtain valuable downstream information that can aid in demand forecasting and provides a means by which they can cope better with environmental demands.

Technology Uncertainty Uncertainty stemming from technical change has been found have negative effects on vertical integration (Balakrishnan and Wernerfelt, 1986). The rationale is that strategic flexibility and lower asset exposure are preferred when the risks of technological obsolescence are high (Harrigan, 1985). Technological uncertainty arises from high rates of technical change, increases in product complexity, and risks of obsolescence (Zuinn and Hilmer, 1994). However, using data collected in a survey of U.S. purchasing managers regarding their relations with their Pacific Rim suppliers, Celly et al. (1999) find that technological uncertainty increases supplier relationship-specific investments as suppliers attempt to manage the uncertainty associated with change by credibly committing to buyers. Their goal is to secure a steady stream of revenue and/or early information on buyer requirements. Concerning these mixed results, we propose the following two possible hypotheses:

Hypothesis 5: In a buyer dominated network, the greater the environmental dynamism, the suppliers' relation-specific investments increase.
Learning intent

Learning intent entails the firm's goal directed arousal with regard to leaning (Maclnnis et al., 1991). Its enthusiasm for and interest in the internalization of knowledge into the firms knowledge stocks rather than mere observation and noting (Hamel, 1991). Learning intent is the firm's desire to learn. It describes how hungry and ambitious the firm is to learn and build competencies. When a firm's learning intent focuses on the building of a particular competence such as interfirm partnering, the firm will be insatiate and energetic in learning activities pertinent to that competence. Since relationship-specific investment could build up a learning platform for suppliers to learn from buyers, strong learning intent implies that the firm is willing to allocate resources accordingly, thus:

Hypothesis 6: In a buyer dominated network, the greater the supplier's learning intent, the suppliers' relation-specific investments increase.

Customer technical innovativeness

Customer's technical innovativeness refers to the extent to which the customer is engaged the development of new and related technologies (von Hippel, 1988). Anderson, Hakansson, and Johanson (1994) and von Hippel (1988) recognize that suppliers may choose to invest in a customer relationship for reasons other than the benefits derived immediately from the exchange. In markets experiencing consolidation and competitive re-ordering, the choice of an innovative customer may have important consequences for the supplier's performance, given that selling to one customer may preclude relationships with other customers. Collaborating with a customer that falters could have serious consequences for the supplier. Thus, innovative customers should be targeted for developing close relationships. It is argued that innovative customers represent a strategic opportunity to acquire knowledge that can be use in other relationships or markets. In addition, innovative customers tend to be more receptive to supplier product initiatives and are more likely to represent an expanding source of demand. Technological innovativeness may also serve as an indicator of a customer's long-term viability as a source of revenue. Thus, we expect:

Hypothesis 7: In a buyer dominated network, the greater the customer technical innovativeness increases supplier intention for relation-specific investments.

Governance Mechanisms—Supplier Development Strategies

The ability to coordinate internal activities with external supplier networks is one of the most critical strategic weapons for many of today's successful organizations (Krause, 2000; Bessant et al., 2003; Simatupang et al., 2002;Burnes and New, 1996). Suppliers directly impact, either positively or negatively, many competitive dimensions including cost, quality, technology, delivery, flexibility, and profits (Park and Hartley, 2002; Reed and Walsh, 2002; Krause et al., 2000). If capable suppliers exist and are selected, a company can use its supply chain for competitive advantage. As a result, drawing upon resource-dependence theory, it is suggested that buyer should reduce the supplier base and make a long-term contract with one or a few suppliers to raise partner's compliment competence. This practice is beyond the traditional purchasing activities and affects the purchasing firm's management of risk. A reduction of the supplier base is risky in the sense that the purchasing firm might be more vulnerable and dependent on one specific supplier. Further, many buying firms report a serious need for supplier improvements in the areas of quality, cost, delivery, innovation, and product design (Morgan, 1993). Moreover, buying firms indicate that suppliers' future capabilities may not meet the future needs and expectations of buying firms without some type of buying firm intervention (Monczka & Trent, 1995). In response to these concerns, buying firms increasingly use supplier development strategies to raise the performance of their suppliers (Watts & Hahn, 1993). This change has accompanied significant modifications in supply chain management strategies over the last two decades. U.S. industrial firms have shifted from adversarial to cooperative relationships with suppliers (Hartley & Choi, 1996) and consolidated their purchases with fewer suppliers (Krause, 1997) to focus on buying from and improving the performance of key suppliers.

Buying firms now use a variety of strategies to improve their suppliers' performance and capabilities. According to Krause et al. (2000), these supplier development strategies are categorized as internalized or externalized activities. The following supplier development activities represent externalized activities in the sense that firms make use of the external

market to instigate supplier performance improvement. The first one is Competitive Pressure, which is applied by a buying firm to its suppliers, when it uses more than one supplier for a purchased item or service, or is willing and able to switch to an alternate supplier. The second one is Supplier Assessment, which are efforts by buying firms represent in-depth evaluations of suppliers' quality, delivery, cost, technical, and managerial capabilities. By providing evaluative feedback to suppliers, it helps to clarify the buying firm's expectations and provide the supplier with direction for improvement. The last one is Supplier Incentives for improvement, which is provided by buying firms to their suppliers include increased volumes of present business and priority consideration for future business for the best suppliers. All these activities used by buying firms to encourage suppliers to improve with little involvement by the buying firm.

In contrast, internalized supplier development activities represent a direct investment of the buying firm's resources in the supplier. Direct Involvement Activities, where the buying firm directly involves itself in the supplier development effort, entails investments by the buying firm in the supplier through activities such as training and education of a supplier's personnel, and dedicating buying firm personnel temporarily to the supplier. This supplier development strategy deserves special attention because direct development efforts represent transaction-specific investments in the supplier by the buying firm. Thus, the direct involvement strategy represents a risk to the buying firm.

Asset specific investments generate rents. Parties incur the expenses and risks associated with such investments in order to capture the associated rents. If a manufacturer did not experience competitive gains (1) from adapting their production process to fit with that of a supplier, or (2) from training that supplier, there would be no incentive for the manufacturer to make these specific asset investments. While specific asset investments do generate rents, the lapse of time between when costs in making the specific asset investments are incurred, and the benefit from these investments are received, creates the need for relationship continuance for the party that has made these investments (Gundlach, 1994). Manufacturers that have invested specific assets in suppliers (eg. production process adaptation, supplier training) incur costs in the present, while the benefits from these investments only materialize over the long-term (e.g. more efficient production, beter quality components). Having invested specific assets in a supplier (e.g. supplier certification), manufacturers will work forward relationship continuance with that supplier, in order to avoid switching costs (Jackson, 1985), and to enjoy the rents which motivated these investments in the first place. Since opportunism undermines relationship continuance, it is expected that manufacturer asset specificity in a supplier will be inversely related to manufacturer opportunism against that supplier. In contrast, when market control mechanisms are employed, often the expectation of relation duration is shorter. It enhances the extent of uncertainty from the supplier perspective. Under this circumstance, suppliers will be hesitated with the specific assets investment. Based on the preceding, it is posited that:

Hypothesis 8: When manufacturers deploy on internalized supplier development strategy, namely direct involvement activities, it will be inversely related to manufacturer opportunism against the supplier. Hence, the more likely the suppliers will involve supplier's specific asset investments.

Hypothesis 9: When manufacturers deploy on externalized supplier development strategy, namely direct involvement activities, it will be positively related to manufacturer

opportunism against the supplier. Hence, the more unlikely the suppliers will involve supplier's specific asset investments.

RESEARCH DESIGN AND METHODOLOGY

Construct Measurement

The construct measurements of research constructs include relationship characteristics (which is composed of dependence structure, and relation norms), supplier development activities (which is composed of direct involvement, supplier incentives, competitive pressure, and supplier assessment), strategic drivers (including environment dynamics, learning intent, and customer 's technical innovativeness), and supplier's specific assets investment.

Sampling Plan

A sampling plan was developed to ensure that certain types of firms were included in this study. We restrict our interest to relationships between manufacturing supplier firms and their customers. Thus, this study selected the companies in Taiwan who manufacture products and export products to foreign buyers for our sample. Following previous research (Kalwani and Narayandas, 1995), the manufacturers coming from computer and allied equipment manufacturers, machine tool equipment manufacturers, electronics and other electrical equipment manufacturers, automotive product manufacturers, and manufacturers of scientific instruments are the focus of this study. The reason for focusing on these industries is that customer firms in these industries have faced intense competitive pressures at the international level. There is documented evidence that to improve their competitiveness in the ever changing global marketplace is essential. On the one hand, manufacturing firms in these industries have been slashing their vendor lists and getting into long-term relationships with a few suppliers. On the other hand, supplying firms are requested to deploy high level of specificity investments to retain the relationship with focal firms (Kerrin, 2002; Celly et al., 1999). Thus, it is expected that these industries are quite suite for our focus of this study. According to the "Directory of Excellent Exporters / Importers in 2002" provided by Ministry of Economic Affairs in Taiwan, in which the selection of excellent exporters/ importers for award in 2002 was based on the criterion of an annual trade performance of at least US$ 8,500,000, it is found that the numbers of populations for our target industries, in terms of Computer, allied equipment & machine tool equipment (CCC Code, 8401-8485), Electronics & electrical equipment (CCC Code, 8501-8539), Automotive product (CCC code, 602-8907), and Scientific instruments (CCC Code, 9001-9209), are 1805, 1919, 350, 617 respectively. Due to the expected number of sample in this study is 900, it is decided that there will be 300, 300, 100, and 200 companies selected from each above industries as our sample.

For abtained the newest companies' information, the sampling frame is mainly obtained from "Taiwan Exporters (2004)," published by Taiwan External Trade Development Council. The following criteria are used for the selection of sample firms for this study. (1) Only the firms in manufacturing sectors are selected. Trading firms without involving into manufacturing are not included in this study. (2) The total annual exporting volume of the firms should exceed one million U.S. dollars. After screening out the potential name list, a random sampling method is used to select the final sample for this study. Totally, 900 questionnaires were sent to the heads of marketing department of sample firms who were supposed to well understand the constructs of this study.

The data were gathered near two months period beginning in middle August of 2004, ad ending in end September of 2004, including one pilot test and one final survey. For the final survey, a total of 900 survey questionnaires were mailed to the sample firms. Out of 900 sample firms, with follow-up telephone calls, 155 completed and returned the answers. A total of 148 questionnaires were usable, producing a response of 16.44 percent.

Characteristics of Customer Relationships, Sample Firms and Respondents

It is shown that 36.8% of respondents report that their specific customers are belonging to brand manufacturers. Following, the second major relationships in this study are coming from the relationships with electronics manufacturing services（about 29.9%）, the others 32.6% are coming from relationships with retailers as well as trading agency. Concerning the equity investment between supplier and customer, almost all the relationships are belonging to non-equity investment relationship（about 84%）. In addition, regarding the nature of the transaction, more than 37.2% of the transactions coming from general procurement in which the level of interaction between supplier and customer is usually lower than the other types, such as sub-contracting (19.3% in this study), customization (21.4%), and in-processing (8.3%). More than 73% of the respondents report that the sales of this specific customer are less than 20% when comparing with whole sales, while 26.2% of the respondents are reporting their major customer who accounts for more than 20% sales. Finally, about 55% of the respondents report that their relationship duration is less than 5 years, while 31.4% are reporting the relationship duration between 5 and 10 years, 13.6% are of more than 10 years.

In addition, in this study, more than 29.73% of sample firms are belonging to computer related industry, 37.16% coming from electronics related industry, 13.51% belonging to automotive product related industry, and 19.59% coming from scientific instruments industry. More than 58% of the firms operate with a comparatively large scale, whose employees are more than 1500. Only 22.1% of the firms spend annual R&D expenditure less than 3% of sales, the others (about 78%) are more concerned with their innovation capabilities. Finally, more than 68.92% of the respondents are working as upper level managers. It is proposed that they will be full of experience regarding interacting with customers.

Exploratory Factor Analysis

To verify the dimensionality and reliability of constructs of this study, purification processes, including factor analysis, correlation analysis, and coefficient alpha analysis were conducted in this study. Factor analysis examined the basic structure of the data. Correlation analysis assessed the degree of multicollinearity among variables. Coefficient (Cronbach's) alpha measured the internal consistency of each identified dimension.

The results show that all variables within a factor tend to have a high coefficient of item-to-total correlation. This suggests a high degree of internal consistency for each dimension. In addition, the high coefficient of Cronbach's α on each factor further confirms the reliability of the measurement items.

Table 1 Results of Reliability Tests

Research Dimension	Research Items	Factor Loading	Eigenvalue	Cumulated Explained Variance	Item-to-total Correlation	Cronbach's α
Specificity Investments	Specificity Investment		3.442	68.848		.8832
	AS1	.643			0.5053	
	AS2	.853			0.7585	
	AS3	.913			0.8440	
	AS4	.889			0.8065	
	AS5	.823			0.7166	
Customer's Power Advantage and Interdependence	Supplier Dependence		1.540	76.996		.7009
	PW 1	.877			.5399	
	PW 2	.877			.5399	
	Customer Dependence		1.716	85.783		.8342
	PW 3	.926			.7157	
	PW 4	.926			.7157	
	Relative Dependence		1.528	76.402		.6911
	PW 5	.874			.5280	
	PW 6	.874			.5280	
	Customer's Power Advantage		1.920	64.014		.7039
	CPA1：Item computed to equal (PW 1-PW3)	.841			.6035	
	CPA2：Item computed to equal (PW 2-PW 4)	.827			.5899	
	CPA3：Item computed to equal (((PW5+PW6)/2)-4)	.728			.4542	
	Interdependence		1.581	79.031		0.7343
	INT1：Item computed to equal (min(PW1, PW3)*2)	.889			.5806	
	INT2：Item computed to equal (min(PW2, PW4)*2)	.889			.5806	

Table 1 Results of Reliability Tests (continued)

Research Dimension	Research Items	Factor Loading	Eigenvalue	Cumulated Explained Variance	Item-to-total Correlation	Cronbach's α
Norm	Norm		2.645	88.177		.9321
	No 1	.912			.8101	
	No 2	.963			.9116	
	No 3	.941			.8619	
Environment Dynamism	Environment Dynamism		2.059	68.643		.7677
	En 1	.810			.5756	
	En 2	.854			.6454	
	En 3	.821			.5902	
Learning Intent	Learning Intent		1.837	91.837		.9084
	IN 1	.958			.8367	
	IN 2	.958			.8367	
Customer's Technology Innovativeness	Customer's Technology Innovativeness		2.831	70.778		.8610
	LE 1	.876			.7564	
	LE 2	.903			.8041	
	LE 3	.778			.6243	
	LE 4	.802			.6543	
Buyer's SD Strategies	Direct Involvement		1.524	76.223		.6852
	SD 1	.873			.5245	
	SD 2	.873			.5245	
	Supplier Incentives		1.463	73.169		.6330
	SD3	.855			.4634	
	SD4	.855			.4634	

Competitive Pressure		1.539	76.937		.7001
SD5	.877			.5387	
SD6	.877			.5387	
Supplier Assessment		1.713	85.653		.8281
SD7	.925			.7131	
SD8	.925			.7131	

RESEARCH ANALYSIS AND RESULTS

To verify the effects of relationship characteristics, supplier's strategic drivers, and buyer 's SD strategies on the supplier's specificity investments, there are following 5 regression models constructed. The results are shown as Table 2.

Model 1 SI = β11 + β12 * SOW + β13 * BOW + β14 * AGE…….(1)

Model 2 SI = β21 + β22 * SOW + β23 * BOW + β24 * AGE + β25 * CPA+ β26 * INT + β27 * NORM....……..……..(2)
Model 3 SI = β31 + β32 * SOW+ β33 * BOW + β34 * AGE + β35 * UNCER+ β36 * INTENT +β37 * INOVA……(3)

Model 4 SI = β41 + β42 * SOW + β43 * BOW + β44 * AGE + β45 * INVO + β46 * INCEN + β47* PRESS + β48 * ASSES……...……...(4)

Model 5 SI = β51 + β52 * SOW + β53 * BOW + β54 * AGE + β55 * CPA+ β56 * INT + β57 * NORM + β58 * UNCER+ β59 * INTENT + β510 * INOVA + β511 * INVO + β512 * INCEN + β513 * PRESS + β514 * ASSES…… ...(5)

Note: SI= Specificity investments; SOW=Supplier's ownership; BOW=Buyer 's ownership; AGE=duration of relationship; CPA=Customer 's power advantage; INT=Interdependence; UNCER= Environment dynamics; INTENT=Learning intent; INOVA=Customer 's technology innovativeness; INVO=Direct Involvement; INCEN=supplier incentives; PRESS=Competitive pressure; ASSES=Supplier assesment.

Among these equations, relationship characteristics (in terms of customer's power advantage, interdependence, and norm), supplier's strategic drivers (in terms of environment dynamics, learning intent, and customer's technical innovativeness), and buyer's SD strategies (in terms of direct involvement, supplier incentives, competition pressure, and supplier assessment) are the dependent variables in each equation respectively. Supplier's ownership, buyer's ownership, and duration of relationship are the control variables.

We used a hierarchical regression procedure to estimate the above equations. In these 5 models, we use Specificity investment as dependence variable. In Step 1, only the control variables (including Supplier's ownership, buyer's ownership, and duration of relationship) were entered. The explained variance of the control variables entered as a block is not significant ($r^2 = .015$, $F = .694$, $p=.557$). In Model 2, the main effect of relationship characteristics was entered. The explained variance of this main effects is significant (change in $r^2 =0.099$, $F = 2.758$). It shows that only Interdependence has a significant effect on Specificity investment. Thus, our previous hypothesis 2 has been supported. In contrast, the hypothesis 1 and 3 could not find supports from the empirical results.

In Model 3, the main effect of supplier's strategic drivers was entered. The explained variance of this main effects is significant (change in r 2 =0.111, F = 3.094). It shows that Environment dynamics and Learning intent have significant effects on Specificity investment. Thus, our previous hypothesis 4 and 5 has been supported. In contrast, the hypothesis 6 could not find supports from the empirical results.
In Model 4, the main effect of Buyer's SD strateies was entered. The explained variance of this main effects is significant (change in r 2 =0.149, F = 3.595). It shows that Supplier incentives, and Competition pressure have significant effects on Specificity investment. Thus, our previous hypothesis 8 has been supported. In contrast, the hypothesis 9 could not find supports from the empirical results.

Finally, all the explained variables are put into model 5 to identify the more influencing variables. The explained variance of this main effects is significant (change in r 2 =0.237, F = 3.113). It shows that Interdependence, and Supplier incentives are the most influencing variables.

Table 2 The Results of Regression Models of Specificity Investments

Variables	Dependence variable: Specificity investments(SI)				
	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	4.677**	3.441**	2.576**	1.990**	.827
Supplier's Ownership	.419	.312	.351	.336	.274
Buyer's Ownership	-.224	-.169	-.167	-.180	-.072
Duration of relationship	.115	.132	.049	.068	.055
Relationship Characteristics					
Customer's power advantage		-.043			-.064
Interdependence		.138**			.109**
Norms		.040			.0060
Supplier's Strategic Drivers					
Environment dynamics			.187**		.098
Learning intent			.195*		.088
Customer's Technology Innovativeness			.072		-.138
Buyer's SD Strategies					
Direct involvement				.069	-.024
Supplier incentives				.259*	.254*
Competition pressure				.139*	.101
Supplier assessment				.070	.088
R2	0.015	.114	.126	.164	.252
Adj-R2	-0.007	.072	.085	.119	.171
ΔR2	0.015	.099	.111	.149	.237
F	0.694	2.758	3.094	3.595	3.113
P	0.557	0.015	.007	.001	0.001
D-W	1.973	1.995	2.011	1.988	2.033

Note: **: indicating a significance level of 0.01, *: indicating a significance level of 0.05

DISCUSSION AND CONCLUSION

The major objectives of this study have been to identify the influencing factors of specificity investments by suppliers. Based on the results of this study, several conclusions can be drawn. The first conclusion is that there are significant relationships between relationship characteristics and specificity investments. In addition, there are significant relationships between supplier 's strategic drivers and specificity. Concerning the relationship between buyer's SD strategies and specificity investments, is that the positive influence of supplier incentive on specificity investments is significant. In addition, it was also found that a higher level of competition pressure is significantly positively associated with the level of supplier's specificity investments. In summary, this research makes several contributions to our understanding of the relationships among relationship characteristic, supplier's strategic drivers, and buyer 's SD strategies, and a supplier 's specificity investments. The proposed framework provides a more comprehensive view of the relationships among these constructs than is available from the extant theory.

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DETERMINANTS OF INFORMATION SHARING OF MOBILE PHONE USERS

Dr. Chung-Chu Liu, National Taipei University, Taiwan
gereliu@mail.ntpu.edu.tw

ABSTRACT

Mobile phone communications play an essential part in our daily life. Information sharing can improve the speed and spreading of information and news. The purpose of this study is to explore determinants of information sharing of mobile phone users. The author obtained data from in-depth interviews through open-ended questionnaire. Content analysis and literature review were adopted to analyze data. According to the results, this research divides determinants of information sharing into four parts: senders' factor, receivers' factor, context factor, and types of information. The results could be formulated a conceptual framework for empirical study in the future. The conceptual framework is also helpful to mobile phone users to evaluate important factors assessment.

Keywords: mobile phone, mobile phone user, information sharing, literature review, content analysis method, knowledge management

INTRODUCTION

It is very important to understand how mobile service companies should interactive with their customer and deliver services (Parasuraman & Zinkhan, 2002). Consumers' use of mobile communication devices is increasing rapidly, and devices based on mobile technology are ordinary in everyday life (Balasubramanian, Peterson & Jarvenpaa, 2002).The growth in the mobile phone industry has in few years accelerated due to constant technological development. Mobile phones have undergone a huge change from being an engineering product to become one of the most popular consumer electronics products (Catalan & Kotzab, 2003). To know their thoughts of mobile phone users is essential. Achieving and maintaining a good quality focus requires a constant attention to customer requirements, improving processes, training, and communications. The literature on information sharing in the business is growing. Some researchers explored the value of information sharing in a two-level supply chain (Gaur, Giloni & Seshardi, 2005; Lee, So & Tang, 2000). Miranda & Saunders (2002) adopted social construction of meaning perspective on information

sharing topic. Lundberg (2008) used a word-of-mouth approach to informal information sharing. However, information sharing of mobile phone usage get less attention. The essence of all this also lies in sharing knowledge (Gross, 2001). Hence, it is an important thing to find out determinants of information sharing of mobile phone users for mobile phone service companies. To sum up, the purpose of this research is to explore determinants of information sharing of mobile phone users and find prioritizations of factors of information sharing.

LITERATURE REVIEW

There are several theories concerning about informational sharing. First, the theory of reasoned action, it assumes that human beings are usually quite rational and makes systematic usage of information available to them (Fishbein & Ajzen,1975). TRA is a widely accepted model in social psychology to explain human behaviors (Ajzen &Fishbein, 1980).Second, the economic exchange theory, according to the economic exchange theory, individuals will behave by rational self-interest. Information sharing will occur when it rewards exceed its costs (Kelly & Thibaut, 1978). Third theory is the social exchange theory. Social exchange theory concerns intrinsic rewards (Blau,1976). Fourth, the social cognitive theory, Bandura(1986) proposed self-efficacy is people's judgments of their capabilities to organize and execute courses of action required to attain goals. Based on the self-efficacy concept, I proposed that the individual's judgment of his capabilities to contribute to the organizational performance is going to be a major factor affecting information sharing. According to these four perspectives, many factors explain individual's information sharing behavior has been identified, however, there are left something undiscovered. Li & Lin(2006) examined the determinants of information sharing and information quality in supply chain management including environmental uncertainty, intra-organizational facilitators, and inter-organizational relationships. Gathering knowledge is easy, but sharing it is harder. More and more firms are starting to realize that knowledge shared is knowledge smartly deployed and leveraged (Dixon, 2002). In summary, the purpose of this study is trying to verify these theories with empirical data and further investigate some new perspectives that ignore by existent theories.

METHODOLOGY

Data Collection

To identify the components of determinants of information sharing of mobile phone users, this study data are gathered from mobile phone users. In-depth interview,

content analysis, and the analytic hierarchy process are used for data collection and analysis.

Sample

Convenience sampling was used for data collection. There are two stages in this study. First, the concept is formulating by six persons. The six respondent persons were selected from National Taipei University students and employees in Taiwan. A general open-ended questionnaire was administered, which focused on the determinants of information sharing of mobile phone users. A total of six users attended in-depth interviews, ranging in age from 19 to 45. In second stage, there are thirty-nine users selected from twelve companies and universities. 46.2 percentages of the respondents were male, while 53.8 percentages were female. This survey result is used to prioritize the measures of information sharing by analytic hierarchy process method.

Data Analysis

The data obtained by this qualitative study was analyzed using the content analysis method (Rourke & Anderson, 2004; Berelson, 1952; Budd, Thorp, & Donohew, 1967; Holsti, 1969). Five main factors were developed using the following conceptual framework: **1. Mobile phone users:** characteristics of mobile phone users including personality, emotion, and verbal capability (Liu & Chen, 2005; Liu, 2008) 2. **Mobile phone receivers**: characteristics of mobile phone receivers including personality, emotion, and verbal capability (Liu & Chen, 2005; Liu, 2008); 3. **Informational characteristic**: characteristics of information nature including secret information, important information, and interesting (Liu & Chen, 2005); 4. **Situational factors:** some context factors which influence information sharing willingness of mobile phone users including time pressure, on the go, and price discount (Liu & Chen, 2005).

Mutual agreement and reliability

The author used three coders to get the mutual agreement and reliability by coding to a formula [2M/(N+O),M: all agreement numbers，N：coder 1 agree; O：coder 2 agree] As mentioned above, the mutual degree of researcher and coder 1 is 10/12, coder 2 is 7/12, coder 3 is 9/12; coder 2 and coder 3 is 7/12, coder 4 is 7/12; coder 3 and coder 4 is 6/12, using a formula of reliability [n(average mutual degree)/ 1+(n-1)(average mutual degree)]. I got the pretest reliability of this study as 0.87 (4＊0.6389/1+3*0.6389). This reliability is acceptable. The content of coding will be

discussed in the following section.

AHP method

The data in this study are analyzed using a multi-criteria decision making approach called the analytic hierarchy process (AHP). The Analytic Hierarchy Process, developed by Saaty (1977), addresses many of the problems mentioned above. Government and business organizations have used it extensively. Expert Choice, Inc, one of the vendors of AHP software, reports thousands of installations of its namesake product on PCs around the globe. Saaty (1994) claims that AHP is combined logic and intuition, and takes advantage of our ability to rank choices. Many articles have been written on the successful implementation of AHP in various environments that involve a selection or decision (Liberatore, and Miller, 1995).

FINDINGS

This study attempts to identify the determinants and prioritization content of information sharing of mobile phone users. The results are presented below.

Table 1 Prioritization of information sharing of mobile phone users

Determinants of information sharing of mobile phone users	Factors	Items	Weightings	Rank	Total weightings	Total Rank
	Mobile phone user (0.242)	Personality	0.376	1	0.091	4
		Emotion	0.310	3	0.075	7
		Verbal capability	0.314	2	0.075	7
		Inconsistency index =0.00				
	Mobile phone receiver (0.206)	Personality	0.319	2	0.066	10
		Emotion	0.367	1	0.076	6
		Verbal capability	0.314	3	0.065	11
		Inconsistency index =0.00				
	Informational characteristics (0.220)	Secret information	0.420	1	0.093	3
		Important information	0.336	2	0.073	9
		Interesting information	0.244	3	0.053	12
		Inconsistency index =0.00				

	Situational factors (0.332)	Time pressure	0.407	1	0.136	1
		On the go	0.348	2	0.115	2
		Price discount	0.245	3	0.082	5
		Inconsistency index =0.00				

The results state that the weightings and rank of determinants of information sharing of mobile phone users follows the order: **Situation factors** (including time pressure, On the go, and price discount), **informational characteristics** (including secret information, important information, and interesting information), **mobile phone user** (including personality, emotion, and verbal capability), and **mobile phone receiver** (including personality, emotion, and verbal capability).

CONCLUSION AND SUGGESTIONS

This study explored determinants of information sharing users developed four factors from mobile phone users' perspectives and organizational theories. Mobile phone industry has become a very popular topic of discussion. To create useful information, this study gathered data from mobile phone users' perspectives. In-depth interviews, content analysis method, and the analytical hierarchy process were used for data collection and analysis. Based on the results, this study divides determinants of information sharing of mobile phone users into four factors: mobile phone users, mobile phone receivers, informational characteristics, and situational factors. The results show the current situation relating to mobile phone industry and provide a reference for examining their strategies and operating effectiveness. Developing new business model for mobile phone service companies is highly necessary in the future. In addition to the contribution, this study raises some challenges for future mobile phone industry research. However, these are important issues in the dynamics of mobile phone industry evolution with no doubt.

This research has some potential limitations. However, information sharing of mobile phone users is a complex and intangible concept which needed to more explorations. This study is merely exploratory and simply represents an initial attempt to investigate. Further work must be required in several ways since the present work suffers from some weaknesses. First, only a small sample is used, and the first step for any future study should be to use a larger sample. Furthermore, the analysis should be extended longitudinally to understanding the progress and development of information sharing

of mobile phone users or should be applied to corporate with mobile phone service companies.

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BUSINESS ETHICS AND QUALITY MANAGEMENT

Dr Fotis Vouzas* and Christina Doufa

***Assistant Professor, Dept. of Business Administration, University of Macedonia, Greece**

vouzas@uom.gr

ABSTRACT

This paper is an attempt to investigate the Business Ethics link to Quality Management. Business Ethics as management practice is well rooted to many organizations but its contribution to quality management implementation programs and practices is not well documented. Today, organizations approach quality using a wide range of frameworks and models for implementation, depending on the work of well known theorists and academics as well as practitioners. The widespread of the new ISO 9000:2000 and the Business Excellence movement through the American and European Quality Awards are the prevailing approaches to quality improvement according to the majority of Quality academics. Both provide a basis for the implementation of a TQM philosophy, a "unique" way of improving organizational performance and attaining competitive advantage.

The main purpose of this paper is to examine the various issues related to Business Ethics such as corporate citizenship, human rights, environmental protection, consumer protection, occupational health and safety, dishonest business practices (corruption, idleness, and weave problems) and investigate the relationship to Total Quality Management. The survey sample consists of one industrial organization certified with the new ISO 9000:2000 series. The data gathering was carried out through extensive and in - depth interviews with several multiple informants i.e. the plant manager, the production manager, the personnel manager, using a semi-structured questionnaire with open - ended questions. The main purpose was to collect data and produce basic information, enabling qualitative observations concerning organizations' Quality and Business Ethics programs and initiatives. The data analysis provides some ground for generalisations, even though subjective judgements were also made from the analysis of the cases.

Keywords: Total Quality Management, Business Ethics, Greece, ISO 9000

INTRODUCTION

Quality has become the most used word in today's discourse. It is used in company's advertisement, annual reports, banners and in the lips of all organization's stakeholders, in government initiatives and even in personal relationships. Organizations worldwide trying to implement various quality initiatives and programs aiming at satisfying customer needs and improving overall organizational performance. However, although the true meaning and the value of quality is gaining ground in all over the world, the figures said a different story. Organizations are facing enormous quality problems in production (defects, scrap), in marketing (customer satisfaction), in logistics (response time, reliability), in finance (quality costs) and in most of their functions, even though the "Quality Revolution" has started according to many authors long time ago.

Some argue that quality is mostly rhetoric and good stories in order for organizations to promote sales and create a "customer-orientation" profile. In United States and in Europe awards were established to promote awareness and provide a basis and a model for TQM implementation. However, the organizations both in US and in Europe were not so enthusiastic about the awards and the numbers are very small in all categories. On the other hand the certification with the new ISO 90000:2000 series of standards is gaining ground and especially in Asia the increase in certified organizations is beyond expectations. But still, many authors state that ISO 9000 is not equal to Total Quality Management but is just a third part quality audit that is not related to final product quality mainly used by organizations as a commercial tool.

Business ethics dissert issues such as corporate citizenship, human rights, environmental protection, consumer protection, occupational health and safety, dishonest business practices (corruption, idleness, and weave problems). There is an increasing demand on focusing at the humanistic dimension and social responsibility of business enterprises. Organizations during the 90's began to invest in formal Business Ethics programs (Weaver, et.al, 1999) especially in the US, by establishing codes of ethics, using telephone lines for reporting ethical concerns and employing ethical officers or creating Corporate Social Responsibility departments. However, according to Donaldson & Dunfee (1994) "the field of Business Ethics has been troubled by a lack of direction ..." and Randal & Gibson (1990) found that research on Business Ethics was methodologically incorrect.

It seems that quality can provide a new agenda and a new direction for the design and implementation of Business Ethics programs and initiatives and create a new language by using a set of frameworks such as Business Excellence models (EFQM , MBNQA) or Quality Management Systems such as ISO 9000 or the ISO 26000 CSR.

In this paper the authors investigate the relationship between quality and Business Ethics by examining the various Business Ethics programs and initiatives such as corporate citizenship, human rights, environmental protection, consumer protection, occupational health and safety, dishonest business practices (corruption, idleness, and weave problems) in a Greek industrial organization.

LITERATURE REVIEW

Total Quality and ISO 9000

One of the most controversial concepts in the history of management theory is the concept of Total Quality Management (TQM). It is considered as a "social movement" (Hackman and Wageman, 1995), a "comprehensive way to improve total organizational performance and quality" (Hunt, 1993) or a "new paradigm in management" (Spencer, 1994; Grant et al., 1994). Its origins can be traced in the work of the -so called- quality gurus, Deming, Juran, Feigenbaum, Ishikawa and Crosby and on the rise and dominance of the Japanese automobile industry in the world markets. TQM emphasizes self-control, autonomy, and creativity among employees and requires active co-operation rather than mere compliance (Wilkinson,et.al. 1991). Hence it could be argued that it has a significant impact on the culture of the entire organization, calling for change, as it is a global philosophy involving all organization's members.

ISO 9000 introduction fifteen years ago created a series of controversies and doubts over the role and the significance of ISO 9000 series on improving product and service quality, achieving internal and external customer satisfaction, and improving performance (Tsiotras&Gotzamani, 1996; Dick, 2000; Van der Wiele et al., 2000; Magd & Curry, 2003; Stevenson and Barnes, 2001; Kartha, 2002.) According to Douglas, et.al (2003) "ISO 9000 is a multi-million-pound industry with many individuals and organizations reliant on it for their livelihood, including quality consultants, lead auditors, internal auditors, supplier auditors,

quality representatives/managers and software designers/sellers as well as the numerous training companies and certification bodies and their employees". However, other authors and among them Kartha (2002) argues that the new standards main purpose is to assist organizations to "identify mistakes, streamline their operations, and be able to guarantee a consistent level of quality".

The new revised standard was launched at the end of 2000 and according to Beckford (2002), is "an attempt to harmonize all the standards and remove the manufacturing bias. Several authors stated that the new ISO9000: 2000 is directed towards performance rather then conformance (Najmi&Kehoe, 2000). Coleman&Douglas (2003) argue that organizations in order to achieve the new ISO 9000:2000 should demonstrate that have quality processes and procedures in place, but they are skeptical about what happens after ISO 9000 certification. Casadesús &Karapetrovic (2005) studying the relationship between the "new" and the "old" ISO found that "the evaluation of the new ISO 9001: 2000 standard is generally positive". Vouzas&Gotzamani (2005) argue that there is no really negative impact but mention that the perceived benefits are less than the previous standard and that the level of reported benefits of ISO 9001/2/3: 1994 decreases with time, evidenced by two empirical studies conducted in 1998 and 2002. Overall argue that there is "an erosion of the perceived usefulness of ISO 9001: 2000 in the future, especially in terms of short-term benefits". Martínez-Lorente & Martínez-Costa (2004) further argue that organizations certified by ISO 9000 "may have gone a part of the way to TQM. However, the authors claim that it is only the "first part of the way, not its end, because there is a large amount of TQM requirements that ISO 9000 does not satisfy". Research on ISO 9000:2000 all over the world is still going on and the perceived benefits and its integration to other quality initiatives is expected to clear the picture and provide a basis for further improvement of the standard (Laszo, 2000; McAdam& Jackson, 2002; Najmi & Kehoe2000,). According to Vouzas&Gotzamani (2005), "careful analysis of the ISO 9000:1994 standards' requirements compared to the basic principles of TQM and the requirements of the two most representative business excellence awards, the European Quality Award and the Malcolm Baldrige National Quality Award, reveals several main shortages of the ISO 9000:1994 standards. The authors stated that lack of strategic quality planning, absence of top management commitment; lack of focus on customer satisfaction, lack of systematic training in quality. Furthermore HR competitiveness, benchmarking, and quality cost measurement are absent, as well as issues related to health, safety and the environment in

a study in Greek EQA awarded organizations. However, many authors believe that the new revised ISO 9000:2000 series of standards is a significant improvement on the previous version in terms of its conceptual simplification, its process-based vision and its acknowledgement of the importance of customer satisfaction as a key requirement for verifying the effectiveness of the quality system (Conti, 2002). The basic principles on which the new standards' requirements are based (as found in the ISO 9000:2000 document) are much more TQM oriented.

Quality and Business Ethics

Douglas Montgomery in an editorial in Quality and Reliability Engineering International Journal (2003) states that organizations embracing the philosophy of Corporate Social Responsibility can enhance their reputation, and gain greater financial returns. Furthermore, argues that quality has a role to play and that Quality has a very strong ethical foundation and all quality gurus' (Deming, Juran) incorporated ethical issues in their writings.

A direct relationship between quality and ethics and social responsibility is that of quality systems such as ISO 9000 and ISO 26000. According to McWilliams, et.al (2006) there is a growing interest on CSR and in ISO 26000 and the main motivations are: coercive, altruistic and strategic. As mentioned earlier ISO 9000 is a Quality Management Systems while ISO 26000 is guidance on social responsibility. Both standards have similarities and difference in their scope, principles and content (Castka & Balzarova, 2008). ISO 26000 can not be certified by a third party, and its scope include issues such as social, environmental and legal diversity in the world and look at them in terms of globalization, climate change, organizational governance and sustainable development, etc. (ISO/TMB/WG/SR, 2006). The ISO 2600 consists of four clauses, the SR context, the SR principles, the SR issues and SR guidance, and its main purpose is to build awareness and created an ethical philosophy within the organization (Castka & Balzarova, 2007).

In the early days of quality movement, authors such as Deming (1986), Crosby (1979) and Peters (1988) stated that quality has a high ethical content. Vinten (1998) states that "TQM is built on a foundation of ethics, integrity and trust. It fosters openness, fairness and sincerity and allows involvement by everyone". Vinten (1998) also believes that "Crisis ethical management comes expensive. The extent of ethical audit depends upon the organisation's

attitude to business ethics and society, as well as to its more immediate stakeholders. Ethical considerations are the only really guaranteed way to ensure this is by the adoption of total quality procedures. There is hardly any management philosophy that is as much adopted by companies as quality management".

According to Svensson & Wood (2005) the core values of quality management should be build upon ethical fundamentals and quality tools and techniques should consider these fundamentals. Quality is about making things right, responsibility for quality lies to all, customer satisfaction is the main drive for success, and profound knowledge is the new name for quality. The main argument is that doing good and doing well is the key to excellence. Organizations can not just invest and focus only on technical-oriented approaches and techniques but rather gave to enhance and utilize their people and contribute to the community. According to Steiner & Steiner (1995) quality, productivity and ethics go hand in hand. Issues such as corporate image, better environment, avoidance of stricter government regulations and the preventions of social problems than their cure are the main elements or aspects of the above relationship. In a study conducted in European organizations, Steiner & Steiner (1995) found that very few organizations of the sample had an ethical culture, and statement or codes of ethics and there was no difference between service and industrial organizations. According to their study results, ethical dimensions should be incorporated to quality management process. Fisscher &´ Nijhof (2005) tried to investigate the implications of Business Ethics for Quality management. The authors argue that quality cannot be managed successfully without an explicit focus on moral values and on the opposite ethical behaviour in a business environment assumes full quality control in order to answer moral questions.

Another aspect of the quality and ethics relationship was examined by Gonzales & Guillen (2002), the ethical dimension of Leadership in Quality. One of the main quality principles is that quality requires top management commitment and that leadership is one of the critical success factors in quality management implementation. The authors state that "the ethical dimension of leadership refers to the right decisions and actions combined with good intentions, and accompanied by moral correctness of behaviours". They suggest that organizations should start building moral trust in their manager's behaviour, by providing them training in ethical issues, give them the opportunity to write ethical statement and create an ethical culture in their function. Svensson & Wood (2005) however found that there are

different expectations and perception between managers and employees concerning corporate ethical issues in TQM.

Finally, in all the so-called Business Excellence models (EFQM model and the Malcolm Baldridge Award) there is a focus on ethical issues and specifically on Corporate Social Responsibility. Impact on society, satisfaction of clients and satisfaction of employees are important elements of the widely adapted EFQM model and the Malcolm Baldridge Award. In this way, quality management leads automatically to moral deliberations and responsibilities towards the different parties in and around an organization (Steiner and Steiner, 1995; Fisscher and Nijhof, 2005).

RESEARCH METHODOLOGY

In this paper, the authors suggest that in order to have a reliable and objective depiction of the Business Ethics on quality improvement frameworks, a thorough examination and analysis should include all the various approaches and perceptions recorded in literature -some of them based on empirical data and some deriving from rhetoric and "good-stories" or "how things ought to be" perspective. The paper examines one industrial organization, a multinational company in the drinks and beverages sector that operates in Greece over 45 years and has a long tradition of corporate social responsibility. The company was among the first organizations in Greece that received the ISO 9000 in the 90's and implementing a series of standards (ISO 9000, ISO 22000, ISO 18001 and ISO 14001) with a strong commitment to quality. The data gathering was carried out through extensive and in - depth interviews asking several multiple informants i.e. the plant manager, the production manager, the personnel manager, using a semi-structured questionnaire with open - ended questions in one of the three plants operating in Greece. The main purpose was to collect data and produce basic information, enabling qualitative observations concerning organizations' Quality and Ethical efforts. The questionnaire was developed based on state-of-the art literature review and consisted of three parts. The first part was questions about the profile of the organization (legal status, number of employees, etc), the second part was about the organizations Business Ethics efforts (policy, programs, initiatives, etc) and the third about the link between quality improvement efforts and Business Ethics and Corporate Social Responsibility. This papers is based on a pilot study of larger scale research aiming at exploring both qualitative and quantitative the link between Business Ethic and Quality. The data analysis provides some

ground for generalizations, even though subjective judgments were also made from the analysis of the case.

FINDINGS

The Company profile

Company is A is one of the biggest organizations in Greece in the Drink and Beverage sector, and the leader in the alcoholic beverages. In the past ten years the company invested almost 300 million Euros in infrastructure and its plants considered the most modern in Europe. The company is a major sponsor of athletic and social events and promotes safe alcohol drinking among young drinkers. The company's advertisement logo is "enjoy responsibly" and in its webpage there are pages dedicate to safe drinking. All company's plants have environmental standards concerning energy consumption (electricity, gas), pollution (water, air, noise) and money spent on introducing environmental friendly production technologies. The company awarded in 1987 with the best award for environmental consciousness and in 1998 with the Corporate Social Responsibility Award. The plant in which the study took place has 300 full time employees and 100 seasonal personnel in approximately 20 specializations. The plant gone through restructuring and infrastructure modifications in the past ten years. From 1996 to 2000 there was a multi-skilling program aiming at enhancing the skills and abilities of the personnel with in majority were coming from the nearby rural community.

Business Ethics

The organization's Corporate Social Responsibility (CSR) issues are in the hands of the Communications Affairs department in the central offices in Athens. The department is new and before that CSR and Business Ethics were handled by the financial department. The main philosophy of CSR in the organizations is that Ethics is everybody's job and all employees from top to bottom are responsible. Furthermore, the company must prove that through everyday practices and culture. Every year the company organizes a CSR conference aiming at building awareness and communicating best practices to all stakeholders.

Employees and management are aware of the importance and value of Business Ethics through the company newsletter and of events taking place inside the organization. The main programs and initiatives introduced and implemented related to the Business Ethics are :

promoting employee participation (many work groups operating at the plant both, functional and cross functional) written commitment of all work groups within the plant on quality and safety, full implementation of ISO 18000, continuous training and coaching, strict numerical goals regarding energy consumption, pollution, recycling, internal and external benchmarking on quality and CSR issues, support of local community, formation of voluntary groups for environmental purposes (cleaning beaches, planting trees on burned forests, etc), schools and university students visits, etc.

However, there are no formal ethical codes that take the form of work practices and responsibilities among employees and managers in the plant. The reason is that people are within the organizations many years and there is no need for written statements and formal ethical policies in the plant according to top management. There are no training programs focused on CSR and Business Ethics on the plant and there are no disciplinary actions in cases of ethical malpractices. The training manager mentioned that the climate is that of a "public organization" meaning that employees enjoy work stability and security and formalities and rules are being incorporated through informal communication.

Over the years the organization and the plant in particular had no incidents of unethical behaviour from managers or employees. The plant manager in cooperation with the management team and the union have day to day communication and the goal is to prevent any actions causing problems (proactive philosophy) inside the plant or affecting customers or the local community. In cases of customer complaints about the product – retailer or final customer- (not proper filling of the bottles, foreign particles inside the bottle, etc) the organization policy is to provide information to the customers and give them the opportunity to visit the plant and the facilities and to get familiar with the production and the quality assurance system.

Today, the organization is trying to be as effective as possible, introducing new technology, utilizing people and techniques and cutting costs. All these are done in accordance with the organizations Corporate Social Responsibility policy and with the change of philosophy. Being effective and financially health depends on ethics and ethics can push organization forward.

Business Ethic and Quality

Quality was always a major concern of the organization since its establishment. The company's products are worldwide known for its supreme quality. The plant is certified with the ISO 9000 since 1994 and as mentioned earlier had two other certifications (ISO 14000 and ISO 18000). The main drive for quality improvement in the plant is the quality improvement teams. The teams were formed with the consensus with the union. Their main goal of the teams is to ensure that quality procedures are understood and implemented without problems. There are a series of financial and non financial incentives in order to promote quality and productivity. Employees get a productivity bonus based on the annual performance appraisal system and there are awards for the best team in the plant. Training is considered an investment because give the opportunity to employees to learn more and become less vulnerable to changes in technology and in systems implementation. The multi-skilling program enhanced employees' capabilities and protects them from being obsolete. This was considered as an ethical-based program from the top management and the employees.

There is a very strong connection between quality and ethics in the plant according to all informants. The plant organization is focused on satisfying customer needs and protecting the public from excessive alcohol drinking. There are annual customer satisfaction surveys and on the spot audits (from the sales department) to the consumer points (supermarkets, café, bars, clubs, etc). The goal is to have zero complaints, zero defects and zero accidents. The company used various quality management techniques and tools such as benchmarking, business process re-engineering, etc in order to monitor and control all quality issues related to ethical problems. Best practices among the company's worldwide plants are articulated and top management people have the opportunity to visit other plants around the world and learn new methods and practices.

The organization is not in the process of applying for the European Quality Award according to the plant manager. Top management is aware that EQA is providing a model for self-assessment and that in the model there is a CSR part. The training manger at the plant said that EQA is the next step and a major challenge for the organizations and for the plant itself. However, believes that many things need to be done before the organization give the green light for the award process such as formal written CSR policy in each plant, appointment of a CSR officer and a long term training program on ethical issues for all personnel.

Finally, ISO 26000 CSR is more than welcomed and the managerial team of the plant believes that is a matter of time to be introduced and implemented.

Conclusions

Business Ethics is a necessity and a major challenge for all organizations around the world. It provides a set of guidelines and a new culture for the future. Quality Management is customer consciousness -both the internal and the external – and its philosophy is a creating a culture in which production is causing no pollution, excessive use of energy and resources, and human traumas. Quality is a mean to prevent ethical problems and change the way organizations think about the product or service and their stakeholders. In quality, financial profit is replaced by value for the people inside and outside the organization. Providing a safe workplace for the employees, keeping the production under environmental standards and creating an ethical new image for the product and the services are the main issues in the ethics-quality relationship. The organization studied is in the process of changing its practices and re-evaluate its policy on ethics. Greece is a country with a long tradition on ethics, from Socrates, Plato and the Greek philosophers, to the new reality.

This paper is a first step of a major research on the Business Ethic and Quality. The research is under way and the authors make the final alterations in the quantitative questionnaire aiming at Greek organizations involved already with CSR and are members of the Greek Network for Corporate Social Responsibility.

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Design for Excellence in ICT companies

Pekka Belt, University of Oulu, Finland
pekka.belt@oulu.fi
Tuukka Mustonen, University of Oulu, Finland
tuukka.mustonen@gmail.com
Janne Harkonen, University of Oulu, Finland
janne.harkonen@oulu.fi
Matti Mottonen, University of Oulu, Finland
matti.mottonen@oulu.fi
Pekka Kess, University of Oulu, Finland
pekka.kess@oulu.fi
Sitthinath Sanpanich, Kasetsart University, Thailand
sitthinath@gmail.com

ABSTRACT

Information and communications technology (ICT) companies have realised that acknowledging the needs of internal customers is a necessity for successful new product development (NPD). Requirements for products have a tendency to change during NPD, and managing requirements has become a significant challenge for ICT companies. This is accumulated by requirements being interpreted differently in different parts of organisations. Design for excellence (DfX) is a potential way for addressing internal customers and for managing requirements. This study shows that DfX concept is systematically utilised only in some advanced companies, and the same challenges are attempted to address in most organisations by using other methods. DfX practices in smaller ICT companies are compared to the similar practices of a successful large ICT company.

Keywords: Design for excellence, Product development, Requirements management, DfX.

INTRODUCTION

The information and communications technology (ICT) sector is facing continuous change in its new product development (NPD) as products are getting increasingly complicated, and customer segments more fragmented. These changes, together with pressures for shortening development times, and severe price erosion, require multidisciplinary approaches. Successful product development necessitates the integration of engineers, industrial designers and marketing personnel. (Seetharaman et al., 2007; Belt et al., 2008; Cooper et al., 2004).

The early stages of product development are emphasised by many authors (Bralla, 1996; Harkonen et al., 2009; Gatenby and Foo, 1990; Yang et al. 2007). The ability to influence the success of a product development programme is the greatest at the start of the project. The choices made in early NPD, reduce both unnecessary changes towards the end, and total life-cycle costs even after the end of the programme. Design for excellence (DfX) is an organised approach to systematically address the early involvement. DfX and Design for Six Sigma have been two of the most popular concepts in quality management in recent years (Jiang et al., 2007).

Addressing the needs of internal customers has been identified as a key element for successful product development (e.g. Cooper et al., 2004; Gupta et al., 2007). Requirements for products typically change during product development, and requirements management

has become an ever greater challenge for ICT companies. This challenge is accumulated by the fact that requirements are interpreted differently in different parts of organisations. DfX is a potential way for addressing internal customers and for harmonising practices. DfX cannot only be seen as a way to collect internal best practices, but also as a means to disseminate information and realise the implementation of these practices.

This paper analyses one advanced ICT company applying DfX, which is selected as a benchmark company, and seven smaller players attempting to address the similar issues by using different methods. The approaches of different small and medium sized enterprises (SME), large companies, and the selected benchmark company are analysed and compared.

The above mentioned can be condensed into the following research questions:

RQ 1 How does a large ICT company manage its requirements through DfX practices?

RQ 2 How do the other approaches applied by other companies differ from the DfX practices of the large company?

This study addresses the research questions in a qualitative manner both, through literature and analysis of industry interviews.

REQUIREMENTS MANAGEMENT AND DfX

There can be seen two main reasons for evolution of product development processes: (1) market changes, and (2) in-house challenges. Market changes include, tightening competition, changes in customer opinions and spending behaviour, and such. These market changes result in demands to reduce costs and shorten time-to-market targets for NPD (Gatenby and Foo 1990; Pahl et al., 2007; Priest, 1988). In-house challenges relate to company functions and processes, specifically to product development and manufacturing. Requirements tend to change during NPD and meeting the needs of both, internal and external customers, results in pressures for the early NPD stages to consider a vast number of different aspects.

Individual designers have traditionally focused on product itself and the value it can provide to the end-user (Bralla, 1996). Typically, they do not consider the product realisation through the entire life-cycle, including manufacturing, disposal, and such. Only after the design is complete, these issues are addressed, and are left for related departments to solve. This has resulted in cumbersome processes that are time-consuming, inflexible, and prone to errors (e.g. Huang et al., 2001).

Design for excellence

Design for excellence (DfX) is an approach that can be utilised to manage feeding requirements back to product development. X in DfX stands for an aspect under concern, such as manufacturing, testability, reliability, assembly, disassembly, cost and so on (e.g. Jablokow and Booth, 2006; Gehin et al., 2008; Barton et al., 2001; Rungtusanatham and Forza, 2005; Jose and Tollenaere, 2005; Haque and James-Moore, 2004). DfX aims to lower costs, increase quality of products and to reduce time-to-market (e.g. Prasad, 1997; Gungor, and Gupta, 1999; Prasad, 2000). In addition, Zuidwijk and Krikke (2008) emphasise the reusability aspects, while Maltzman et al. (2005) highlight quality and customer satisfaction.

The requirements of manufacturing were the first needs of internal customers that were addressed in the essence of DfX. Examples of the first approaches to address manufacturing

issues include value analysis, value engineering, and produceability engineering (Bralla, 1996; Huang et al., 2001). These methods can be seen to share the same goals as modern DfX. Boothroyd & Dewhurst (1983) are the first ones to utilise design for excellence with their concept of design for assembly. The DfX concept was later broadened into design for manufacturing to include a broader set of manufacturing aspects (e.g. Chang et al., 2005; Stoll, 1988; Chang et al., 2007). Recently DfX methodology has expanded to cover new areas, such as environmental, serviceability, and testing issues (Kurk and Eagan, 2008; Graedel, 2008; Bras, 1997; Coulter and Bras, 1997; Tichem, 1997). It has also become imperative to harmonise product and process design of product families within a supply chain framework. (Lau et al., 2007; Rungtusanatham and Forza, 2005).

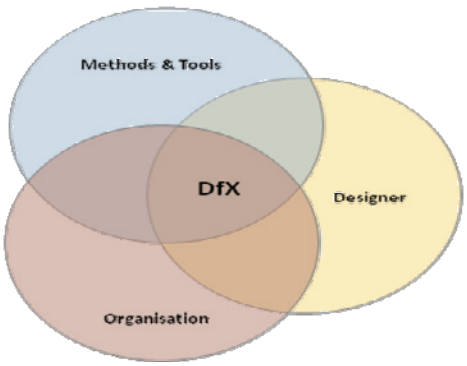
Companies applying DfX have realised how following these principles has an enormous impact on company procedures, and organisation itself (Sheu and Chen, 2007). Adequate communication within a company is required for an effective utilisation of DfX (Skander et al., 2008). Cooperative work, checklists, guidelines, and software tools are utilised to achieve the goals set by different DfX sub-disciplines, (e.g. Huang and Mak, 2003; Eversheim and Baumann, 1991; Boothroyd and Dewhurst, 2008).

The literature also presents some critics for DfX. Applying DFX in large organisations poses difficulties due to complex organisational structures, and overwhelming number of issues to be considered (Herrmann et al., 2004). There are also challenges with teamwork, costs of organisational support, tools required, and so on.

DfX structural components

DfX can be roughly divided into the following three domains: (1) designer, (2) methods & tools, and (3) organisation (see Figure 1). Designer typically is a skilled R&D engineer, who applies DfX principles in practice. Methods can be seen as procedures and guidelines that the designer follows. Typical tools include spreadsheets, software, design structure matrices, morphological charts, and such. Organisational aspects cover issues, such as teamwork, collaboration, communication, processes, and company policies. (Eversheim and Baumann 1991; Poli and Knight, 1984; Huang and Mak, 1997; Meerhamm, 1994; Lang et al., 2002).

Fig. 1 the three identified structural DfX components



At practical level, designer implements DfX, conducts design related decisions, and produces engineering drawings by utilising different tools. Designing is essentially a decision-making process on product features and functions (Cowan et al., 2000). Designer utilises various approaches and tools, however, the key is engineer's ability to produce documents on products and processes. Lang et al. (2002) summarise designer's main activities as:

1. identification, analysis and clarification of problems and needs
2. information gathering
3. idea creation
4. generation of solutions
5. analysing solutions
6. solution optimisation

Iterations are required, and the designer must go through the steps listed above until a satisfying solution is reached. Multiple issues require consideration, resulting in an overwhelming amount of alternatives. Often requirements conflict and designer has to decide which requirement to favour. However, in some cases a solution can benefit the requirements of several DfX sub-disciplines, such as a reduced number of parts resulting in both easier assembly, and higher environmental friendliness (Harjula et al., 1996). In order to find an optimal value within a solution domain, objective measurement, suitable tools and sound judgement are required. The aim should be to make decisions early as possible, however, only when necessary understanding has been gained. (Bralla, 1996; Morgan and Liker, 2006).

Table 1 presents the differences between traditional engineering design, and modern design with DfX.

Table 1 Differences between traditional engineering design and modern design with DfX.

Traditional	Modern with DfX
Consider functional requirements	Consider life-cycle requirements
Address other aspects after design freeze	As early as possible
Overwhelming number of alternatives	Overwhelming number of alternatives
Iterations	One-time-right
CAD tools	Knowledge-based systems
Responsibility over design	Responsibility over whole life-cycle

The work to fulfil DfX objectives can be supported by various methods & tools, which can automate and guide the actual efforts. Because DfX bases on tool-heavy engineering design, DfX tools have gained a lot of attention (e.g. Tichem and Storm, 1997; Watson and Radcliffe, 1998). Recently, the shift has been towards computerisation of tools, and knowledge-based systems, allowing storing and reusing design knowledge (Nomaguchi and Fujita, 2007). In addition, these tools ease the cross-functional integration needed in modern product development process.

Tichem (1997) categorises DfX tools as: (1) design guidelines, (2) stand-alone design evaluation tools, (3) CAD (computer aided design) integrated evaluation tools, and (4) CAD/CAPP (computer aided process planning) based evaluation tools. Design guidelines are lists of qualitative DOs and DON'Ts. Stand-alone design evaluation tools offer systematic approach to evaluating design and redesign. CAD integrated evaluation tools use the power of computerised modelling for analysing design and creating feedback to designer thus helping evaluation (Eversheim and Baumann, 1991). CAD/CAPP based evaluation tools automatically create process plans in addition to CAD output. (Tichem, 1997).

Addressing DfX in practice requires acknowledging the entire organisation, not only an individual designer (Herrmann et al., 2004). DfX implementation requires new procedures and processes as well as organisational changes. In order to support DfX, different measures are used to ease integration of people, processes and tools.

A successful implementation of DfX requires organisational reformulations, clear sharing of responsibilities, and training, but also cultural changes (Herrmann et al., 2004). New practices supporting DfX should be integrated into existing business environment (Huang et al., 2001). Table 2 presents differences between traditional NPD and modern NPD with DfX.

Table 2. Differences between traditional NPD and modern NPD with DfX.

Traditional	Modern with DfX
Technical focus	Organisational support
Business process re-engineering	Continuous improvement
End-user as customer	Downstream as customers
Communication between departments	Collaboration between team members
Departmental knowledge	Knowledge sharing
From upstream to downstream	Both directions
Iterative, emphasis on reviews	Continuous process
Bureaucracy	Empowerment
Departments	Cross-functional teams
Project	Process
Direct communication	Shared communication through systems
Processes on basis of product design	Integrated design
Feedback after identifying problems	Proactive information sharing

In the literature, various issues have been linked to DfX. These issues include cross-functional teams, empowerment, design reviews, standardisation, knowledge sharing, continuous improvement, and such. (Bralla, 1996; Gatenby and Foo, 1990; Tichem, 1997, Cowan et al., 2000; Sheu and Chen, 2007; Huang, 1996a; Herrmann et al., 2004; Lang et al., 2002; Wilkinson, 1998; Cooney, 2004; Aurich et al., 2006).

Due to the nature of DfX, single design engineer cannot sufficiently handle, and know everything that is required during a design process (Bralla, 1996). In order to tackle this problem, cross-functional teams, comprising participants from different life-cycle phases and functions, are established (e.g. Huang, 1996a).

RESEARCH PROCESS

The research process is described in Figure 2. Design for excellence was first studied by using existing literature as the key source. The study was conducted in a large company applying DfX and seven smaller companies to clarify how they address similar challenges. The large company was first analysed and was identified to successfully apply the DfX concept and could therefore be used as a benchmark. The study was then expanded to also cover other companies.

Several workshops were organised in the large company to discuss the practical realisation of DfX. Interview questions were formulated based on the obtained understanding see Appendix A. Altogether twenty interviews were organised in the large company, comprising multiple sites and countries. The interviews included all the DfX managers as well as responsible managers for vital internal processes.

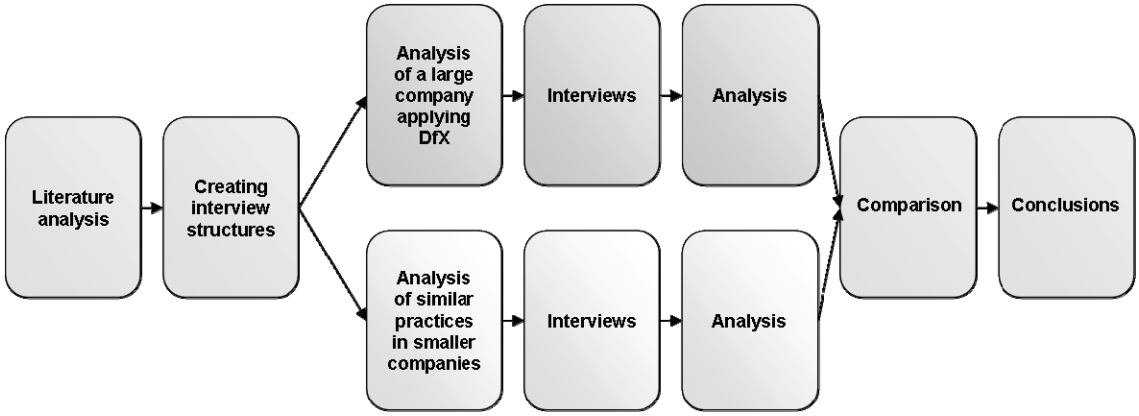
Interviews in the smaller companies include seven companies, where one key person was interviewed in each utilising a slightly different questionnaire, see Appendix B. The

questionnaire was modified as it was assumed that the smaller companies were not necessarily aware of the term DfX.

The research utilised a semi-structured thematic interview approach (see e.g. Merton et al., 1990). The interviews were conducted informally, in a qualitative manner, allowing the interviewees to explain and clarify the cases and topics as entities. All the interviews were transcribed and analysed.

The results were analysed by reflecting them against the existing literature, and comparing the practices of the large ICT player against the smaller ones. The results of the analysis are presented in the section Results and analysis.

Figure 2. The research process



RESULTS AND ANALYSIS

General NPD characteristics

The NPD process in the interviewed SMEs is typically only roughly modelled and documented.

The interviewed large companies utilise a more structured approach to NPD than their smaller counterparts and aim to model their processes. The large companies utilise different documents and methods, such as checklists, templates, milestone reviews, detailed project plans, and manuals. Strict control is applied for processes, including quality reviews, assigned process ownerships and such. Company processes are regularly reviewed and updated.

The benchmark company utilises fully modelled documented NPD process.

Practical approach to internal downstream requirements

The interviewed SMEs have not internalised the concept of DfX, however, they apply practices that are the essence of DfX. Addressing internal requirements is conducted in cross-functional project teams. Often they are forced to operate in a fire-fighting mode, solving problems as they appear without necessarily considering the big picture. These companies rarely reach full optimisation, with proactive addressing of all relevant issues during NPD, and considering total costs over the entire product life-cycle. Practical requirements optimisation, and problem solving is, nevertheless, in critical issues conducted together with

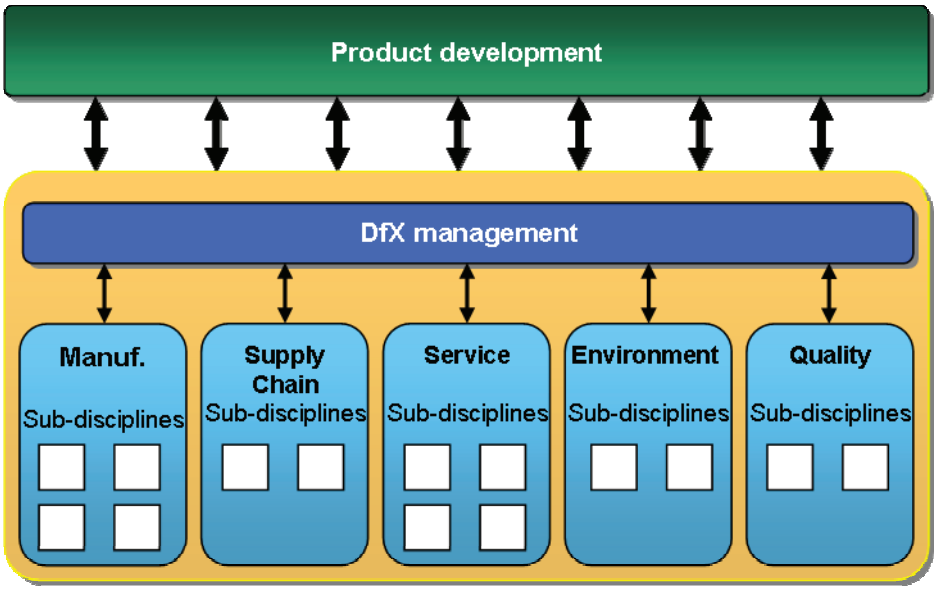
manufacturing sub-contractors. Internal requirements are rarely considered systematically during pre-study phase, and when considered, this occurs during product development.

The large interviewed companies address DfX related issues, regardless of not necessarily utilising the term. Internal requirements are addressed through concept owners collecting requirements from internal customers, and utilising cross-functional project teams. These practices are integrated in company quality systems. However, know-how does not sufficiently accumulate as requirements are only occasionally documented in the form of design guidelines, checklists and manuals. In software development, each programmer is responsible for the aspects of later phases, such as unit tests. Companies utilise programmer / tester pairs, and daily milestone meetings, to achieve functional agility and to address testing needs. In contrast to SMEs, large companies attempt to systematically optimise the entire development chain and total costs. There is focus on DfX related issues already during the pre-study phase, and separate research/piloting/evaluation projects are utilised.

In the benchmark company, the role of DfX is to ensure that the needs of manufacturing, supply chain, after-sales service, environment and quality are taken into account already during product development. Manufacturing, supply chain, service, and quality have all been divided into relevant sub-disciplines, managed by assigned persons. The benchmark company has a common DfX management organisation, which coordinates different DfXs and communicates their needs into product development. DfX is seen to aid the company to optimise different matters from the perspective of total costs, as DfX sub-discipline managers are required to justify their requirements from the cost viewpoint. Figure 2 describes the DfX system of the benchmark company.

Design for excellence has been conducted for a long period of time in the benchmark company, and is seen to function well. At a higher level DfX provides principles and general guidelines for product development, and at practical level, DfX means exact, often numerical, requirements, tools, design rules. The application of DfX concept has expanded from manufacturing to cover a wider set of activities, including supply chain aspects, reliability, environment and such.

Figure 2 the DfX system of the benchmark company.



Knowledge transfer

Knowledge transfer in relation to internal requirements in the studied SMEs, is conducted by utilising learnings from previous projects, feedback from prototypes and pilot projects. Personal communication and meetings are seen to dominate over proper documentation, and the emphasis is on latter part of NPD process. In addition, the interviewed SMEs utilise knowledge transfer to/from customers and subcontractors.

The interviewed large companies have a more systematic approach to knowledge transfer, compared to their smaller counterparts. They use feedback from previous projects prior to start new ones. Feedback from prototypes and internal training also aid in transforming useful knowledge into relevant guidelines. The emphasis of knowledge sharing is on documents and different forms of electronic communication, such as DOORS® tool are utilised. Communication, at all levels inside the organisation, and among partners is attempted to organise well.

The benchmark company has appointed separate discipline owners for each DfX sub-discipline, who are the key actors in knowledge transfer. In addition, the overall DfX management collects best practices and attempts to further develop common communication tools and methods. The benchmark company has an aim to formulate requirements into exact instructions, and general guidelines that are easy to comprehend by product development. Regular training is also arranged within the company. The data system tools used in practice include Focal Point™ for management aspects, and DOORS®, for more practical engineering purposes.

Managing DfX aspects

The interviewed SMEs utilise ordinary project management solutions for handling internal requirements. These solutions include utilisation of project managers and project meetings for coordination of DfX related aspects. In addition, some SMEs have separate meetings for different design areas to ensure proper coordination. Typically, the responsibility of production manager includes assuring the inclusion of manufacturing requirements, either through personal attendance, or appointing someone from the production organisation.

The interviewed large companies use similar project management solutions as the SMEs. In addition, some of them utilise new product introduction (NPI) groups to assure fluent production ramp-ups, and separate supply chain management (SCM) groups for outsourced production. The company quality organisation has also an influence over managing DfX aspects.

The main difference between the benchmark company and other interviewed companies is the separate DfX organisation and appointed DfX discipline owners. This arrangement enables the benchmark company to manage requirements through total cost calculations, and written guidelines and data systems, making requirements management more systematic and effective. The experience by the benchmark company highlights that DfX is a concrete way to manage complex and sometimes conflicting requirements. Other companies tend to utilise more or less ad hoc solutions and are forced to operate more in a fire-fighting mode. However, noteworthy is that a smaller company does not necessarily have acute needs to be as structured in their requirements management.

Table 3 summarises the central findings of the empirical results.

Table 3 Addressing internal downstream requirements in product development

Issues	SMEs	Large	Benchmark
NPD characteristics	roughly modelled and documented	moderately modelled process - checklists, templates, milestone reviews, detailed project plans, manuals - strict supervision - quality reviews - process ownerships - processes updated 2-4 times a year	fully modelled well documented
Practical realisation	cross-functional project teams fire-fighting mode instead of full optimisation practical optimisation and problem solving together with manufacturing sub-contractors heavy focus on design phase, only minor during pre-study	cross-functional project teams concept owners collect requirements from internal customers design guidelines – partially design manuals - only occasionally integrated in company quality system each programmer is responsible for downstream aspects, e.g. unit tests programmer / tester pair – agile sw development checklists, reference manuals, coding guidelines emphasis on pre-study daily milestone meetings attempts to systematically optimise separate research/piloting/evaluation projects	Guidelines, training cross-functional teams cost calculations

Knowledge transfer	lessons learned from previous projects pilot projects knowledge transfer between partners feedback from prototypes personal communication and meetings instead of proper documentation	after-sales feedback prior to project start internal training feedback from prototypes communication at all levels electronic communication emphasis of knowledge sharing on documents useful knowledge is transformed into guidelines DOORS tool knowledge transfer between partners	discipline owners DfX management organisation requirements formulation internal training design guidelines DOORS & Focal point tools
Management	project manager project meetings separate meetings for different design areas production manager	programme meetings NPI group company quality organisation milestone meetings SCM group for outsourced production programme manager	programme manager programme meetings NPI group company quality organisation DfX management milestone meetings DfX owners

CONCLUSIONS

Addressing the needs of internal customers has been identified as a key element for successful product development. Requirements for products typically change during product development, and requirements management has become an ever greater challenge for ICT companies. This paper analyses one advanced ICT company applying DfX for managing requirements, and seven smaller players attempting to address the similar issues by using different methods.

The advanced benchmark company has a separate DfX organisation and appointed DfX discipline owners to manage requirements. This arrangement enables the company to manage

requirements through total cost calculations, and written guidelines and data systems, making requirements management more systematic and effective. The experience by the benchmark company highlights that DfX is a concrete way to manage complex and sometimes conflicting requirements. This study proves, in contrast to some literature, that DfX is not a philosophy, but rather works through principles and tools.

Other companies tend to utilise ad hoc solutions and are forced to operate more in a fire-fighting mode. Requirements management is addressed as a project management issue, and through prototyping, the focus being more towards the end of NPD. Communicating requirements is based more on undocumented personal communication and project meetings. However, projects aim to clarify and document lessons learned.

Other companies could learn from the benchmark company, and its systematic practises for managing requirements and addressing the needs of internal customers. Companies should consider what the key internal issues to be addressed are in their business context. Especially larger companies could learn from the systematic approach of the benchmark company in relation to DfX. However, smaller companies do not necessarily have acute needs to be as structured in their requirements management, and the needs of internal customers can be addressed effectively by using less systematic methods.

This study concentrates on analysing a limited number of companies in one business sector. The obtained results could vary to some degree, should a wider set of companies, or different business sectors, be included in the study. This study was qualitative in nature interviewing relevant managers involved in DfX related issues. A different research approach might lead to slightly different conclusions.

Potential topics for further study include studying how other advanced companies manage their DfX approaches. Examples from other business sectors would also be beneficial.

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APPENDIX A

Questionnaire

Name
Title
Organisational unit

1. Please describe what you understand with requirements management and requirements? (Specifications, needs, constraints, etc.)
    - How do requirements relate to your area of responsibility

2. Where does your organisation unit get its requirements?
    - What type of requirements – please give examples

3. To which organisational units, within the company, do you set requirements?
    - What type of requirements – please give examples

4. How are requirements prioritised?
    - How would you develop the prioritisation of requirements

5. What are the main challenges relating to requirements management form your organisational unit's perspective – How would you attempt to rectify these issues?

6. How do you view DfX (Design for Excellence)?

7. How does the view over requirements vary – in your opinion – in different parts of the company (for example different sites, different functions: product development, production etc.)?

8. How have the changes in the company organisation influenced requirements management?

APPENDIX B

Company:
Business sector:
Main products:
Turnover:
# of employees:

Questionnaire

1. What are your main products? What kind of value does your company provide to its customers?
2. Who are your main clients?
3. Could you describe your product development process?
4. How do you manage requirements in your product development? What type of requirements?
    a. Who are the stakeholders that set the requirements (internal, external)?
    b. How are the requirements categorised and prioritised?
    c. Do the requirements change during product development / product life-cycle?
5. How are the needs of the following actors in the value chain acknowledged during product design?
    a. Production
    b. Testing
    c. Packaging
    d. Logistics
    e. Service/maintenance
    f. Disassembly
    g. Sub-contractors
    h. Environment
    i. Others?

Practices

6. How do you acknowledge the product life-cycle in practice?
    a. Requiremenets management
    b. Product design
    c. Cross-functional teams
    d. Data systems
    e. Others?
7. What type of cooperation is there between product development and the following phases (production, testing, packaging, etc.)?
    a. Timing / during which phase?
    b. How is the communication arranged?
    c. Do you simultaneously develop the product, and the following phases? How?
8. How do you manage life-cycle aspects during product development?

    a. Coordination/management?
    b. Reviews
    c. Assessment
    d. Intensives/penalties?
9. What type of challenges do product development and the following phases face in their cooperation?
    a. What type?
    b. How do you currently attempt to solve these challenges?
    c. What is your view to improve the situation in the future?
10. What type of tools and data bases does your product development utilise? How is the product life-cycle acknowledged?
    a. Engineering tools
    b. Management tools
    c. How are the data systems, data bases, linked to these tools?

11. Are the following concepts used in your company, How?
    a. Concurrent/simultaneous engineering / integrated design,
    b. Taguchi method / robust design,
    c. Quality function deployment (QFD),
    d. Product life-cycle management,
    e. Cross-functional teams?
12. Do you use DfX?
13. Other comments?

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KNQWLEDGE CREATION AND INTELLECTUAL CAPITAL OF BANKS

Dr. Kuang-Hsun Shih, Chinese Culture University, Taiwan,
shihsteve33@gmail.com
Doctoral student Hsiao-Chen Chang, Chinese Culture University, Taiwan,
Jean91525@gmail.com

ABSTRACT

Purpose *– This paper collates academic definitions and measurements of knowledge creation and intellectual capital, and conducts a survey of the Taiwanese banking industry to establish an understanding of the sources of knowledge creation, and its relationship with creation of intellectual capital in domestic banks.*

Design/methodology/approach*– This paper adopts the knowledge management measurement to examine the formats of knowledge creation on evaluation of relationship between different elements in the intellectual capital of banks by structural equation modeling (SEM).*

Findings*– The performance of knowledge creation has significant influence on the accumulation of subsequent human capital. The performance of human capital exhibits significant influence on structural capital and customer capital. The performance of customer capital reports significant influence on the formation of structural capital.*

Research limitations/implications *– The ability to create knowledge is highly relevant to intellectual capital in the banking industry. Companies should define their own robust mechanisms for knowledge creation to improve their ability in knowledge creation.*

Practical implications *– The managers in the banking industry should identify the ways to cultivate in-depth contents of intellectual capital and have comprehensive development on intellectual capital to create differentiated advantages and boost corporate competitiveness.*

Originality/value *– The importance of tangible assets is waning that has been gradually shifted to knowledge and intellectual capital, and thus, knowledge management has become an important strategy in corporate competition. Organizations have been redefined as platforms that can create knowledge and accumulate intangible, intellectual capital.*

Paper type *– Research Paper*

Keywords: knowledge creation, intellectual capital, financial institution management, financial services operation.

INTRODUCTION

The arrival of a knowledge-based economy has caused the diminishing importance of

tangible assets. Knowledge has become a powerful tool for corporate competition. Guthrie (2001) suggested that successful companies do not gain benefits with only tangible assets, and they mainly rely on access to intangible information and knowledge creation as their major resources for success. The traditional concept of evaluating enterprise value and performances with tangible assets has gradually given way to a focus on intangible knowledge development and integration ability. Intangible knowledge development and integration ability is a set of thorough management skills that can develop and restructure human capital, structural capital, and customer capital of an organization. With systematic integration, internalization, and the advantage of knowledge benefits, companies are able to create core competitiveness. Wu (2002) indicated that for knowledge-type companies, creation, accumulation, sharing, and integration of knowledge are the momentum for the creation of corporate value and sustainable operations. Creation, management, measurement, and evaluation of core intellectual capital will be an important indicator of the value of corporate competitiveness in the future.

Since the implementation of the Financial Holding Company Law in 2001, many financial holding companies have been established. These companies can be divided into three systems, securities and investments, banking, and insurance, as based on their operations. Different from the manufacturing industries, the financial service industry provides knowledge-based products or services. Although securities and investments, banking, and insurance sectors are all under the financial service industry, they have different industrial characteristics. The securities and investment industry focuses on professional services provided by personnel; the banking industry emphasizes on the flows of overall infrastructure; and the insurance industry centers on customer relationship management. Although they have differing focuses, the purpose is the same: the construction of intellectual capital for the company and enhancement of market value. The financial industry has begun integrating professionals and market needs long ago to realize profits from financial knowledge and risk management. Due to the characteristics of the banking industry, it has to stay abreast of the business cycles of all other industries. Meanwhile, the banking industry is highly regulated in its operations. Over recent years, under the influence of financial liberalization and internationalization, the banking industry has seen noticeable changes in their business environment. This, combined with fierce competition, has created tremendous pressures for banks. In an environment of high uncertainties and looming crises, banks should not only more efficiently integrate their work force, financial assets, and other tangible assets, but also improve their ability in the management of intellectual capital to achieve sustainable operations. For the banking industry, it is imperative as to how to use techniques in knowledge management to accumulate intellectual capital to cope with an increasingly changing environment.

Most previous literatures addressing intellectual capital have focused on the correlation between intellectual capital and organizational performances. There are relatively few discussions on the relationship between knowledge creation and intellectual capital, and even fewer studies on such a relationship in the banking industry. The core competitiveness of the banking industry is highly reliant on the ability of management teams to systematically manage knowledge and experience. It also depends on whether they are able to create sophisticated skills catering to the intellectual capital of their organization to effectively manage risks and create profits.

The accumulation of intellectual capital and knowledge creation is closely related (Rezgui and Yacine(2007); Lin, Liu, Hsu, and Wu (2008)). Intellectual capital is generated via systematic integration of knowledge. It is particularly so for the banks, because the knowledge required for banking operations is more complex than in most industries. Such knowledge is known for their diversity and abstractness. From the selection of the management team, the development of professional skills of employees, nurturing of the creativity of employees, accumulation of innovative and creative capabilities, screening of customer groups, management of customers' loyalty, and the management of trademarks and brands to develop and manage strategic partners, all sources of enterprise value through the creation and management of corporate knowledge. This paper examines the empirical studies on knowledge creation and intellectual capital to generalize the important factors concerning knowledge creation and intellectual capital. The major purpose is to explore the relationship between knowledge creation and intellectual capital through the construction of the correlation patterns between these two elements. In addition, this paper also aims to examine the relationships between human capital, structural capital, and customer capital. With the deployment of the correlation patterns between knowledge creation and intellectual capital, this paper hopes to provide practical suggestions for the reference of the management of domestic banks.

LITERATURE REVIEW

1. Definition of Intellectual Capital

"Intellectual capital" was first proposed by Galbraith (1969), as a form of knowledge, intellect, and brainpower activity, which uses knowledge to create value. A company can create differentiated advantages with this capital; it highlights the gap between market value and book value. The importance of intellectual capital has been widely acknowledged by scholars. Stewart (1997) indicated that intellectual capital refers to the aggregation of all

knowledge and competences of employees that can bring about competitive advantages for companies. Any intellectual materials that can create wealth, such as knowledge, information, techniques, intellectual properties, experience, learning ability of organizations, and customer relationships, can be the most valuable assets and most advantageous tools in competition. Shaikh (2004) and Phusavat and Kanchana (2007) suggested that any knowledge capabilities stemming from manpower, creativity and innovation, organizational structure or affiliated parties can be classified as intellectual capital, providing it can store and convert knowledge for value creation in the future or translate implicit knowledge of employees into explicit knowledge for organizational structurization. Schiuma and Lerro (2008) believe that human, relational, structural and social capital as the four main knowledge-based categories building the knowledge-based capital of a region and find that policy makers for the definition of policies oriented towards the development of regional knowledge asset domains to develop regional innovation capacity. Walsh, Enz, and Canina (2008) indicated that the investments of companies in the enhancement of human capital, structural capital, and customer capital would increase their organizational values.

Some scholars widely define intellectual capital as the knowledge owned and applicable by organizations. Dzinkowski (2000) regarded intellectual capital as the total inventor of capital or knowledge-based resources owned by an organization. Therefore, intellectual capital is the intellectual properties or intellectual assets transferred by knowledge. Al-Ali (2003) stated that intellectual capital is the knowledge, experience, and brainpower of employees, as well as the knowledge resources stored in the database, systems, workflows, cultures, and management philosophy within an organization. Bontis (2004) proposed that intellectual capital is a stock of knowledge at a given time. Schiuma and Lerro (2008) argued that the most important activity in the management of intellectual capital is the improvement of organizational flows and management techniques to create knowledge assets.

Other scholars proposed that intellectual capital is intangible assets within an organization. Mayo (2001) stated that intellectual capital is the synonym of knowledge, information, intellectual properties, experience, and other intangible assets. Mason (2006) indicated that intellectual capital is an intangible asset. It can be defined as “the aggregation of the employees and internal structure of a company”. Intellectual capital includes three types: (1) delivery and management system of company information; (2) the abilities of employers and employees, and when the employees leave, the company loses the intellectual capital; (3) the relationship connectors with external organizations, such as relationship with customers, goodwill, and reputation.

Other scholars define intellectual capital with different perspectives. Rastogi (2000) stated that intellectual capital is the ability owned by an organization as a whole to constantly face existing and potential challenges, and respond in a creative and effective manner. McElroy (2002) suggested that intellectual capital should include social and innovative capital that enhances the internal value of companies with mutual trust, mutual benefits, shared values, networks, and norms. Petty, Ricceri, and Guthrie (2008) argued that intellectual capital is the link between personal knowledge within group of an organization, and it can serve as a basis for decision-making.

2. Constituents of Intellectual Capital

The definitions and the elements used to measure intellectual capital can be somewhat different across industries, and therefore, the measurement methods can be different as well. Some scholars divide intellectual capital into two types. Petty and Guthrie (2000) defined intellectual capital as "structural capital" and "human capital". Human capital refers to employees' competences and human resources of external parties accessible by companies. Structural capital refers to elements, such as corporate flows, software systems, and supply chains. Joia (2000) also divided intellectual capital into "human capital" and "structural capital". The difference is whether the capital can be bought. Human capital is not tradable and not owned by the organization, it is a result generated by professional knowledge and skills of employees. According to the positions within and outside the organization, structural capital can be classified as "flow capital", "innovation capital" and "relationship capital". Flow capital is the internal operational flows of an organization, and the external operational flows of the organization with other parties. Innovation capital refers to the ability to create new knowledge with existing resources and is the result of an organization's culture. Relationship capital is the interaction between the organization, customers, suppliers, contractors, and other affiliated parties.

Dzinkowski (2000) divided intellectual capital into three types: human capital, organizational (structural) capital, and customer (relationship) capital. Human capital refers to employees' knowledge, education, professional certificates and qualifications, work-related know-how, work assessment, mentality assessment, innovations, aggression, and the ability to respond and change. Organizational capital refers to intellectual properties and infrastructure assets, such as patents, copyrights, design rights, trade secrets, trademark services, management philosophy, corporate cultures, management procedures, information systems, and network systems. Customer capital refers to customers, customers' loyalty, distribution channels, corporate partners, good contracts, and licenses.

Roos, Bainbridge, and Jacobsen (2001) divided intellectual capital into three types: human, relationship, and organizational. Human capital refers to employees' capabilities, skills, and intelligence. Relationship capital refers to the relationships between all related parties and stakeholders. Organizational capital includes workflows, systems, structures, trademarks, intellectual properties, and other intangible assets owned by the companies, but cannot be shown in the balance sheets. Meanwhile, Shih (2008) measured intellectual capital with 4 dimensions, as based on the characteristics of intellectual capital in the financial service industry. These 4 dimensions are human capital, innovation capital (training & development), flow capital (IT system), and customer capital. The conclusion is that customer capital of the financial industry is dependent on employees' training and product development. However, the correlation with the investment in IT systems (as flow capital) is relatively low. The enhancement of innovation capital is hinged on high-calibre human capital. This is how the creation flows work for the intellectual capital of the financial industry.

3. Knowledge Creation

For a country or a corporation, knowledge is a foundation required for survival and development. Knowledge is the main input/output for companies. The absorption, digestion, and production of knowledge will become the main activities of companies. Therefore, knowledge will become the cornerstone of sustainable competitive advantages for companies. Banking is a typical knowledge-intensive industry, as it involves the activities of knowledge exchange. Hence, knowledge is the source of core competitiveness for the securities and investment industry. The first step of knowledge management is the creation of new knowledge. The creation of new knowledge may come from within or without an organization. The process of knowledge creation within an organization may be through learning, research & development, experience accumulation, and learning by doing. The source of external knowledge can be absorbed and generalized via interactions with suppliers, customers, and competitors. Chang and Lee (2008) indicated that the capability to obtain knowledge can positively and significantly affect knowledge administrative and technical innovation. The research also shows that external environment and organizational culture have significant interaction effects with knowledge accumulation capability on organizational innovation.

Nonaka and Takeuchi (1997) suggested that the creation of knowledge is gained via the interaction of implicit knowledge and explicit knowledge. The process of knowledge conversion is required to generate new knowledge. The conversion process includes 4 elements (Figure 1):

- Socialization

Socialization refers to the process for implicit knowledge to become explicit. It is mainly through passing down and sharing personal experiences, and thus, there is no need to go through written words. For example, knowledge passed down from a master to a disciple. However, socialization is a rather limited knowledge creation pattern. While the disciple can learn skills from the master, neither the disciple nor the master has a systematic understanding of the skills because their knowledge may not be converted into the explicit. It is impossible to allow the whole organization to easily use all knowledge.

- Combination

  Combination is the process for implicit knowledge to become explicit knowledge, mainly through storage, combination, and classification to make the explicit knowledge systematic. For instance, a CFO of a company collates information throughout the organization to compile it into a financial report. The financial report is a new knowledge because it combines information of different sources. However, the combination does not really expand the current knowledge base of the company.

- Externalization

  Externalization is the process for implicit knowledge to become explicit knowledge. The sharing of knowledge is mainly through metaphors and conceptual assumptions. For example, a CFO of a company does not actually produce a conventional financial report, but rather, he develops an innovative budgetary control method, which is based on implicit knowledge he has accumulated over years of experience.

- Internalization

  Internalization is the process for explicit knowledge to become implicit knowledge, mainly via inspections and applications. The process socializes, externalizes, and combines the explicit languages, texts, pictures, or information, and then internalizes it into personal knowledge. In other words, when the whole organization is able to share the new explicit knowledge, other employees can start to expand, extend, and redefine their implicit knowledge.

Marr, Gupta, Pike, and Roos (2003) divided the sources of knowledge creation into three types: autopoetics, cognitivists, and connectivists, as shown in Figure 2. Autopoetics refers the development of personal knowledge amid difficulties in delivering information and knowledge because the sources of the knowledge are personal interpretations or translated data within an organization. The master and disciple system is an example. Cognitivist refers to authentication, collection, and dissemination of propaganda information as the main activities of knowledge development. An open organization develops more accurate and precise knowledge through the absorption of new information. Knowledge development can be stored systematically within a system based on general principles. This type is mainly to construct a solution in order that the created knowledge can be systematically shared. The

common approach is to formulate a set of standardized operational procedures (SOP). Connectivists and cognitivists have a lot in common. The only difference is that in connectivists, there is no predefined solution. Rather, it is believed that the source of information stems from the connection of information. Therefore, knowledge creation should focus on the exchange and sharing of information. The usual approach adopted by companies is brainstorming and workshops, and the connecting approach is team-oriented. It is regarded that knowledge creation relies on the communication of internal information. The relationship between individuals is like independent networks within an organization, and knowledge exists in the interchanges of the networked information. Knowledge creation is focused on the disseminated and delivered informational flows within an organization.

From \ To	Implicit Knowledge	Explicit Knowledge
Implicit Knowledge	Collectivity: process of creating implicit knowledge via experience sharing (common knowledge)	Externalization: implicit knowledge expressed with metaphors, analogies, concepts, or assumptions through models (conceptual knowledge)
Explicit Knowledge	Internalization: knowledge passed down with words and stories or made into manuals and documents (operational knowledge)	Combination: the process of forming a knowledge system by making concepts systematic (systematic knowledge)

Figure 1 Knowledge Creation Model; Source: Nonaka & Takeuchi. (1997)

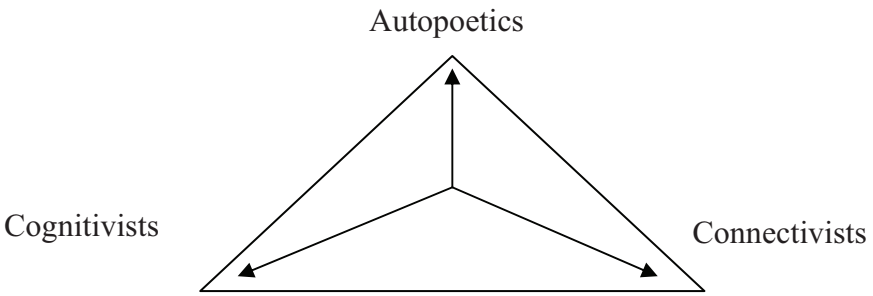

Figure 2 Types of Knowledge Creation; Source: Marr et al. (2003)

RESEARCH METHOD

1. Research Structure

This paper constructs its research structure, as shown in Figure 3, in accordance with the characteristics of the banking industry, and literature addressing types of knowledge creation and structure of intellectual capital.

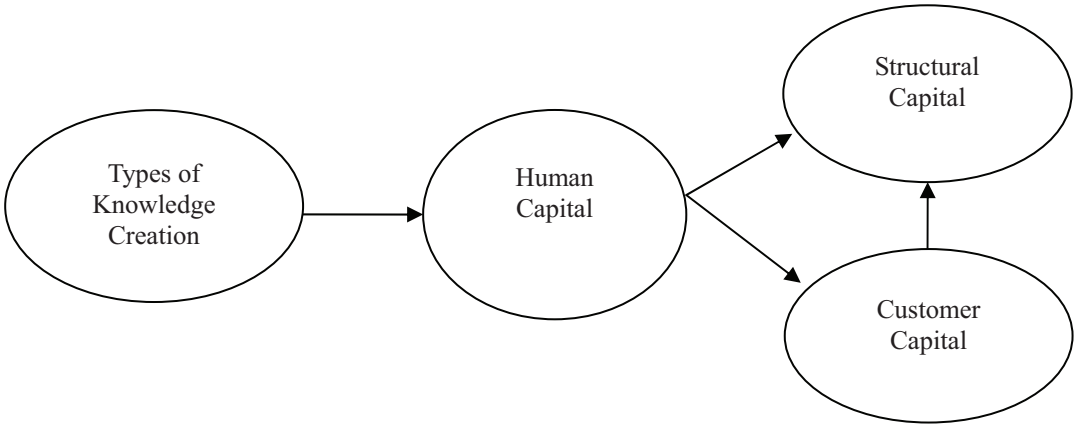

Figure 3 Research Structure

2. Research question

Al-Ali (2003) suggested that intellectual capital is employees' knowledge, experiences, and brainpower, as well as the knowledge resources stored in the databases, systems, flows, cultures, and management philosophies, and is the aggregation of all these resources. Afiouni (2007) proposed that the management activities in human capital and knowledge management help to improve operational performances of an organization. Meanwhile, Schiuma and Lerro (2008) indicated that the most important activity in the management of intellectual capital is to improve knowledge assets of organizational flows through diverse methods that improve organizational performances. This paper first examines the relationship between knowledge creation and intellectual capital of the banking industry. Knowledge creation uses employees as a medium. Intellectual capital can only be created with resource investments and management in a systematic method within an organization. Therefore, this paper assumes that knowledge creation and human capital of the banking industry are correlated.

As far as the contents of intellectual capital are concerned, Reed (2000) suggested that the contact between employees and customers enable employees to understand customers' needs and provide better responses. From the customers' end, they can determine the services that their organization should improve or increase. It facilitates the conversion of human capital into customer capital. Kaplan and Norton (1996) also indicated that the interactions between employees and customers may trigger absorption of information, and it can transform knowledge formats for the organization. They can be stored within the organization so that

information can be shared with others. In other words, the better competences employees have, they more they are able to understand customers' needs and develop customer relationship capital to boost customers' satisfaction. Greiner, Böhmann, and Krcmar (2007) stated that an organization whose business strategy requires process efficiency (product/process innovation) should rely primarily on a codification strategy (a personalization strategy). In addition, both Sveiby (1998) and Chareonsuk and Chansa-ngavej (2008) indicated that the companies with abundant human capital could not only boost the operating efficiency, but also accumulate solid structural capital. High-caliber employees and leaders constantly provide services catering to the needs of different customers or partners, in order to establish, maintain, and develop customers' relationships. This results in the accumulation of customer capital. To sum up the above literature review, this paper examines the correlation between knowledge creation and human capital of the banking industry, and analyzes the correlation between human capital, structural capital, and customer capital of the banking industry.

3. Research tools

This paper adopts the knowledge management measurement proposed by Bukowitz and Williams (1999), as a reference structure to examine the formats of knowledge creation. This measurement focuses on the evaluation of intellectual capital. It covers the day-to-day information gathering of organizational members, personal learning on the job, value creation for the re-utilization of knowledge, and the feedback of knowledge flow cycles to the knowledge management system of companies. Meanwhile, this paper refers to Marr et al. (2003) as the major structure of the formats of knowledge creation to be examined. The measurement for human capital (as part of intellectual capital) is designed by modifying the 5 questions proposed by Youndt, Subramaniam, and Snell (2004). The measurement for organizational capital is based on the 4 questions of Youndt et al (2004), with an emphasis on storage in memory devices of an organization, established organizational knowledge, and systematically recorded experiences. Meanwhile, the measurement for customer relationship capital is developed by modifying the questions designed by Bontis (1997) to assess customer capital. In addition, this paper refers to the measurements and indicators proposed by Stewart (1997) and Dzinkowski (2000) for human capital, structural capital, and customer capital.

EMPIRICAL ANALYSIS

1. Data collection

The sample population includes 6 branches of privately owned commercial banks, 3 branches of state-owned banks, and 1 branch of a credit cooperative. There were 15 to 20 questionnaires issued to sales personnel and supervisors, with at least 3 years in service, at each branch. A total of 500 questionnaires were released, with 194 were recovered. The following table shows the basic data of the respondents of the effective questionnaires. (Table 1)

2. Reliability and validity analyses

All the dimensions of this study report Cronbach's α over 0.7, reaching high reliability standards, which indicate that the measurement design is highly credible. Table 2 shows the detailed data. Meanwhile, content validity refers to the fitness of the contents of the measurement tool. The verification of content validity in social sciences depends on the professional knowledge of researchers. It is also possible to identify appropriate and relevant measurements from literature or employ the assistance of experts to determine the fitness of the contents, to enhance content validity, and ensure questionnaire effectiveness. The development of measurement tools in this paper is based on generalization of literature reviews. All the sources are referenced in relevant empirical literature. The questions are modified after interviews with experts. Therefore, the questionnaire in this paper should carry a certain degree of content validity.

Table 1 Sample Characteristics

Sample characteristics	No. of Samples	%	Accumulative %
Sex			
Male	63	32.5	32.5
Female	131	67.5	100
Age			
20~29	114	58.8	58.8
30~39	67	34.5	93.3
40~49	11	5.7	99
50~59	1	0.5	99.5
Above 60	1	0.5	100
Marital status			
Single	144	74.2	74.2
Married	50	25.8	100

Tenure			
Below 5 years	131	67.5	67.5
6~10 years	42	21.6	89.1
11~15 years	14	7.2	96.3
16~20 years	2	1.1	97.4
Above 20 years	5	2.6	100
Education			
College	46	23.7	27.3
University	115	59.3	83
Post graduate	33	17	100

Table 2 Summary of Dimension Reliability

Dimension	No. of items	Cronbach's α
Autopoetics	7	0.842
Cognitivists	7	0.812
Connectivists	7	0.798
Human capital	9	0.922
Structural capital	10	0.897
Customer capital	8	0.904

3. Structural Equation Modelling (SEM)

Figure 4 shows the parameter estimates of the structural model of this paper. Afterwards, an inspection of the estimates of the model and assessment of the overall fit indicators and modification index (MI) can be made to evaluate model fit.

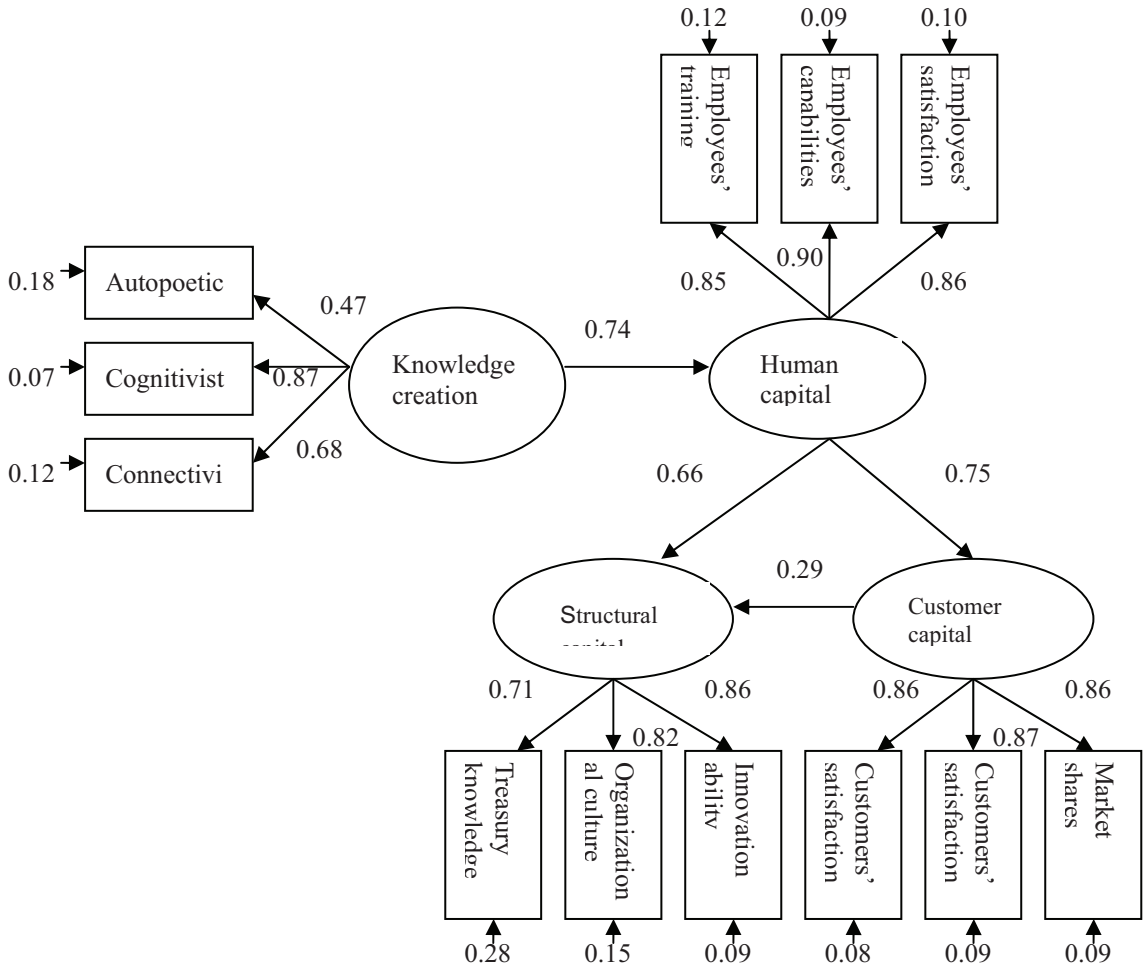

Figure 4 Standardized Parameter Estimates of Path Analysis

4. Measurement Results of Observed Variables & Selection of Estimation Methods

Table 3 shows the averages and standard deviations of observed variables. Meanwhile, according to the skewness and slopes of individual variables, Kline (1998) made the following comments on coefficients of skewness and coefficients of kurtosis. He suggested that when the absolute value of the coefficient of the skewness of the distribution of variables is greater than 3, it could be regarded as extremely skewed. If the absolute value of the coefficient of kurtosis is greater than 8, it has reached a critical point. If the coefficient of kurtosis is greater than 20, it is seriously critical and can be regarded as an extreme case. If the coefficient of skewness or kurtosis has such an issue, it is necessary to consider the estimation methods not subject to the variable distribution. The coefficients of skewness for the observed variables, in this paper, range from -0.484 to 0.327, and the coefficients of kurtosis range from -0.354 to 2.032. The results show that an estimation method, with a normal distribution, does not seriously affect the robustness of the estimates. Therefore, this

paper uses the maximum likelihood estimation method as its model.

Table 3 Measurements of Observed Variables for Path Analysis

Potential Constructs & Observed Variables	Average	Standard Deviation	Coefficient of Skewness	Coefficient of Kurtosis
Knowledge creation				
Autopoetics	4.06	0.48	-0.484	2.032
Cognitivists	3.60	0.55	0.117	0.063
Connectivists	3.79	0.48	-0.063	0.224
Human capital				
Employees' training	3.33	0.68	-0.074	0.245
Employees' capabilities	3.34	0.65	0.226	-0.354
Employees' satisfaction	3.41	0.63	-0.028	-0.310
Structural capital				
Treasury knowledge	3.23	0.75	-0.102	-0.080
Organizational culture	3.39	0.69	-0.314	-0.008
Innovation ability	3.52	0.60	0.087	-0.121
Customer capital				
Customers' satisfaction	3.57	0.57	0.312	0.090
Customers' loyalty	3.39	0.61	0.327	-0.066
Market shares	3.49	0.59	0.099	-0.191

5. Validation & Analysis of Research Issues

This paper uses a structural equation model for validation and analysis of the examination of reasonability of the research structure and the results of the research issues. Table 4 shows the validation results of the structural model. The standardized coefficients of knowledge creation and human capital are 0.74, and t-value is 7.18, $P<0.001$, reaching statistical significance. The results indicate that knowledge creation has positive, and direct, influence on human capital. Meanwhile, Cognitivists and Connectivists are considered the main knowledge creators in the banking industry. The standardized coefficient between human capital and structural capital is 0.66, t value is 6.47, and P is less than 0.001, also reaching statistical significance. These numbers suggest that human capital has positive and direct influence on structural capital. The standardized coefficient between human capital and customer capital is 0.75, t value is 9.70, and P is less than 0.001, also reaching statistical significance. These numbers suggest that human capital has positive and direct influence on customer capital. The standardized coefficient between customer capital and structural capital

is 0.29, t value is 3.24, and P is less than 0.001, also reaching statistical significance. These numbers suggest that customer capital has positive and direct influence on structural capital.

Analysis results show that, the methods of knowledge creation by employees in the banking industry have direct and significant influence on the formation of human capital. The direct impact of human capital on customer capital is significantly greater than that of human capital on structural capital. The direct impact of customer capital on structural capital is the smallest.

Table 4 Validation Results of Structural Model

Research Issue & Path	Standardized Coefficient	Standard Error	t value	P
Knowledge creation -> Human capital	0.74	0.19	7.18	***
Human capital -> Customer capital	0.75	0.07	9.70	***
Human capital -> Structural capital	0.66	0.10	6.47	***
Customer capital -> Structural capital	0.29	0.10	3.24	**

Note: ** indicates P<0.01; *** indicates P<0.001

In addition, the higher the model fit, the higher usability the model has, as far as the model fit assessment is concerned. That also means that parameter estimates are more meaningful. This paper refers to absolute fit indicators, incremental fit indicators, and goodness of fit index recommended by Hair, Anderson, Tatham, and Black (1998) for the validation of overall fit. Table 5 shows all the overall fit indicators. Among the absolute fit indicators, the GFI value of this model is 0.932, RMR value is 0.016, and RMSEA value is 0.066, all within an acceptable range, as suggested by past scholars. Huang (2004) suggested that if the RMSEA value is between 0.05 and 0.08, it implies a good fit.

As far as incremental fit indicators are concerned, the AGFI value of this model is 0.877, NFI value is 0.948, CFI value is 0.977, and IFI value is 0.977. All the values reach the standards suggested in literature, with the exception of AGFI. However, the AGFI is fairly close to the standard. Meanwhile, among the goodness of fit index, the PNFI value of this model is 0.618 and PCFI value is 0.636. They are both greater than 0.5, reaching the standards suggested by previous scholars.

Table 5 Overall Model Fit of Path Analysis

Fit Indicator	Criteria	Validation Value	Result
Absolute Fit Indicators			
P	P>0.05	0.004	Close
GFI	>0.9	0.932	Compliant
RMR	<0.05	0.016	Compliant
RMSEA	<0.05	0.066	Close
Incremental Fit Indicators			
AGFI	>0.9	0.877	Close
NFI	>0.9	0.948	Compliant
CFI	>0.9	0.977	Compliant
IFI	>0.9	0.977	Compliant
Goodness of fit index			
PNFI	>0.5	0.618	Compliant
PCFI	>0.5	0.636	Compliant

CONCLUSION AND SUGGESTIONS

The purpose of this paper is to examine the correlation between knowledge creation and intellectual capital of the banking industry, as well as the correlation between human capital, structural capital, and customer capital, as the three types of intellectual capital. The research finds that knowledge creation in the banking industry has positive and direct influence on human capital. The smoother the channels are for employees to create knowledge, the higher the human capital of the banks; as a result, there is positive influence on structural capital and customer capital of the banks. In other words, with comprehensive knowledge creation mechanisms, banks can effectively enhance their intellectual capital. This finding is consistent with that of Schiuma and Lerro (2008), that the most important activity in management of intellectual capital is the creation of knowledge variety. It can improve the flows of knowledge creation for an organization, and accumulate more knowledge assets. Meanwhile, as far as the sources of knowledge creation are concerned for employees in the banking industry, cognitivists are the most important and have the most significant influence on human capital, followed by connectivists. Autopoetics reports the least influence on human capital.

Intellectual capital consists of human capital, structural capital, and customer capital. This study finds that human capital in the banking industry reports positive, and direct, influence

on structural capital and customer capital. Customer capital also exhibits positive and direct influence on structural capital. Namely, banks with rich human capital not only boost their operational efficiency, but also accumulate good structural capital. High-caliber employees develop customer relationships with their professional knowledge, experience, and capabilities and promote the accumulation of customer capital. Meanwhile, interactions between employees and customers trigger more digestion and absorption of information so that information can be shared within the organization, and thus, the accumulation of structural capital increases. This finding is consistent with Shih (2008), who suggested that human capital has the same positive influence on structural capital and customer capital in the financial service industry. However, it is in contrast with the statement that structural capital exhibits negative influence on customer capital.

As far as the perception of the dimensions of intellectual capital by the employees in the banking industry is concerned, this paper finds that employees' competences are the most important element of human capital, followed by employees' satisfaction and employees' training. When it comes to structural capital, innovation ability is the most important, followed by organizational culture and treasury value. In terms of customer capital, customers' loyalty is the most important, followed by customers' satisfaction and market shares. In other words, employees' competences, satisfaction, and training have positive influence on structural capital and customer capital. Customers' loyalty, satisfaction, and market shares also exhibit positive influence on structural capital.

The ability to create knowledge is highly relevant to intellectual capital in the banking industry. Companies should define their own robust mechanisms for knowledge creation to improve their ability in knowledge creation. The sources of knowledge creation should include autopoetics, cognitivists, and connectivists. For autopoetics, domestic banks should improve their mentoring systems in order to convert the implicit knowledge not able to be expressed with words or texts within the organization into explicit knowledge. For cognitivists, banks should establish and integrate a variety of IT systems to facilitate the exchange and sharing of knowledge. Examples are databases, work samples, and instruction manuals within the organization. It is also possible to invite highly seasoned professionals to give speeches and encourage employees to sit for examinations to obtain certificates and qualifications. As far as connectivists are concerned, banks should provide all kinds of formal, and informal, communication channels, such as job rotations, discussions, intranet forums, meeting rooms, and tea areas to enhance the ability of the organization to create knowledge.

The managers in the banking industry should identify the ways to cultivate in-depth contents of intellectual capital. They should have comprehensive talent development programs for

their human capital by providing complete training and education to expand the professional knowledge and skills of employees. They should encourage employees in a timely manner to enhance employees' satisfaction. In terms of structural capital, the mangers should strive to improve the operational flows of their companies by enhancing the innovation capabilities and bettering the value of the knowledge treasury within their organizations. As far as customer capital is concerned, they should provide high value added products and services, as well as a clean and comfortable environment to maintain a good long-lasting relationship with customers. Xu and Walton (2005) and Liew (2008) suggested the integration of knowledge management (KM) and customer relationship management (CRM) is a strategic issue that has strong ramifications in the long-term competitiveness of organizations. This will increase customers' satisfaction and loyalty, and hence, market shares. For domestic banks, the interaction and mutual influence of human capital, structural capital, and customer capital will benefit the accumulation of intellectual capital, create differentiated advantages, and boost corporate competitiveness.

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Intellectual Capital in the public sector: Implement the IC Process to Formulate Community Traditional Knowledge Management Strategy

Pitipong Yodmongkon, College of Arts, Media and Technology, Chiang Mai University, Thailand
pyir@hotmail.com

Nopasit Chakpitak, College of Arts, Media and Technology, Chiang Mai University, Thailand
nopasit@camt.info

ABSTRACT

This paper presents a study of developing the action-oriented concept of managing traditional knowledge by applying of an intellectual capital process to the Mea-hiya community, Chiang Mai, Thailand. The research has been identified through exploratory research conducted in co-operation with Mea-hiya community cultural council by using qualitative methods.

The paper discusses that the intellectual capital process has much to offer in illuminating how strategies are identified and responded directly to the community cultural situations. The process tries to be realistic by heaving a measuring method which means the process is more quantifiable. The paper describes the process of how strategies were formulated, development and deployed in shifting the Mea-hiya community to manage their traditional knowledge systematically.

Keywords: Intellectual Capital, Traditional Knowledge management, public strategy.

INTRODUCTION

Today, we live in a global village that has an increasing complexity which makes each party interdependent of each other. The global changes have led some people to adopt a new attitude in appreciating the concept of ownership and sole benefits of the ownership (Convention on Biological Diversity, 1992). These attitudes have expanded to cover the usage of the traditional knowledge of the community. Nowadays, current disputes are caused by two main factors. 1) Misuse of the community's traditional knowledge which leads to the disrespect of the traditional knowledge. 2) Exploitation of community traditional knowledge without receiving any permission from the community or sharing it to the community (WIPO, 2006).

Thailand is blessed with her community's traditional knowledge which is deemed as the nation's precious resource. However, the abundance in the community's traditional knowledge has induced many disputes. First, the piracy of traditional knowledge, this problem is partly due to the lack of intellectual property protection. From a comprehensive study, it is apparent that Thailand does not have an appropriate law to handle these type of issues (Setsirote, & Donavanic, 2005). Second, the way of life in Thailand has been constantly changing. After World War II, there had been three waves of development for the Thai local community. The first wave began in the 1960s with the government's attempt in bringing new technology to the local community. The second wave was in the 1970s when people from the local community migrated to find work in the urban area. The third wave was in the 1980s with the penetration of television into almost every rural household, and with an increasing number of rural children entering secondary education. Thus, these three waves have brought upon a new attitude, lifestyle, and modern beliefs to the local people within their community (Bager, 2003). Third, there is a lack of local cultural managing to conserve the traditional knowledge. Traditional knowledge is a community capital; however, communities still lack the process to manage the cultural heritage systematically. For example, local people use story telling as a method of transmitting traditional knowledge from generation to generation especially within their family (Chiyasak, Rajchagool, Pinyosinwat, Kesmanee, Apakaro, & Yodmongkon, 2007). Telling story requires a good interpretation. But due to the changes, people might interpret and understand things differently based on their experiences. This misunderstanding leads to a misuse and a misleading of their traditional knowledge.

This study seeks to develop the new concept of managing traditional knowledge by applying the intellectual capital process that is recommended for the Thai local community (the Mea-hiya community, Chiang Mai, Thailand). The structure of the paper is as follows: a literature review on related issues is presented at the second section. The third section presents the research framework. The fourth section presents the findings, the fifth section presents discussion and the last section presents the conclusion.

LITERATURE REVIEW

Report on Case study of Improper Exploitations of Cultural Property and Folklore

Chiyasak et at, 2007 examined case studies in 4 regional parts of Thailand: north, northeastern, central and south. The results of the study showed that, at all regional parts, Thai cultural property and folklore have been exploited improperly, but the characteristics and forms of those problems were different; for example, problems about race, acceptance and social equality, problems about improper exploitation of cultural heritage such as cultural distortion, improper exploitation of cultural heritage for commercial purposes, and personal claims for the intellectual property right in cultural heritage that must be belonged to the community property; thus, community members face some problems about the exploitation of such cultural heritage.

Regarding case studies on improper exploitations of intellectual property, the Researcher examined the case of registering the Hmong traditional embroidery as an intellectual property in the North and of constructing hotels at public areas of Cha-am Beach. According to such case studies, it is evident that such cultural heritage has been exploited improperly; individuals or business entrepreneurs claimed for the intellectual property right in the community cultural heritage. In the above cases, ones playing prominent roles in claiming for the community right were community members who actually own that cultural heritage. They formed a group requesting all related government bodies to solve their problem. This shows that the community takes a significant role in protecting its own cultural heritage. Therefore, the Researcher conducted an additional study on the development direction and changes of a local community and practice of Muslim community for Zakat case at Lad Bua Luang Community, Phra Nakon Si Ayutthaya. The results confirmed that community power was essential for any movement to protect the cultural heritage in each area.

Thai legal protection on traditional knowledge

According to studies on related laws of Thailand, some provisions associated with traditional knowledge, which is defined herein as intangible cultural heritage, have been set forth in laws; namely, a) The Constitution of the Kingdom of Thailand, B.E. 2550 (A.D. 2007) in 3 Sections: Section 66, Section 86(2) and Section 289. However, those provisions do not give explicit definitions, which possibly cause the ambiguity while the scope of related wordings is based on the different understanding among persons involving in drafting the Constitution and persons to be further enforced by such provisions; b) Patent Act, B.E. 2522 (A.D. 1979); and c) Copyright Act, B.E. 2537 (A.D. 1994). For b) and c), they seem relevant to the right in the traditional knowledge, but, after a close look, both laws are not designed for the traditional knowledge protection; hence, certain fundamental principles as well as their essence are different from those of traditional knowledge such as right given to a person and community right, etc. As a result, it deems inappropriate to use those two laws to protect the traditional knowledge (Sersirote, & Donavanic, 2005; Pullvanich, 2005). Nevertheless, there are another 2 acts appropriate for studying the guideline of laws on traditional knowledge protection, including d) Plant Protection Act, B.E. 2542 (A.D. 1999) e) the Protection and Promotion of Traditional Thai Medicine Act, B.E. 2542 (A.D. 1999) and f) Historical Sites, Materials, Arts and National Museum Act, B.E. 2535 (A.D. 1992). These three acts contain specific qualifications and protection guidelines close to the traditional Thai knowledge; for example, establishing the exclusive right for intangible objects for an individual right holder or a particular group, or the authority given to local organizations to take into account the commercial exploitation of plants as well as making agreements on profit sharing, etc (Chiyasak et al., 2007).

Intellectual Capital (IC)

Intellectual Capital (IC) is defined as the sum of a company knowledge (its' members) that is contributed to an improved competitive position of the organization by adding value to the

defined key stakeholders (Edvinsson, 1997; Marr, 2004). In the knowledge economy, competitive advantage of business relies on values of ICs that allow businesses to create, innovate, and achieve better productivity (Stewart, 1997). Skandia was the first company who developed an IC reporting model named the Navigator (McConnachie, 2007). Skandia distinguished IC into two categories, the structural capital and the human capital. Structural capital is defined as infrastructure that organizations develop to commercialize their human capital. It includes both direct and indirect support, and for each there are both physical and intangible elements (Edvinsson, & Sullivan, 1996). Structural capital includes customer capital (external) and organizational capital (internal). Organizational capital consists of innovation and process capitals. Process capital is the sum of a company's know-how. Innovation capital includes intangible assets and intellectual property which is the source of renewal for the company. Human capital is defined as the collective capabilities of the employees' competence, attitude and intellectual agility (Roos et al., 1997). This asset includes experience, skills, and know-how of the employees.

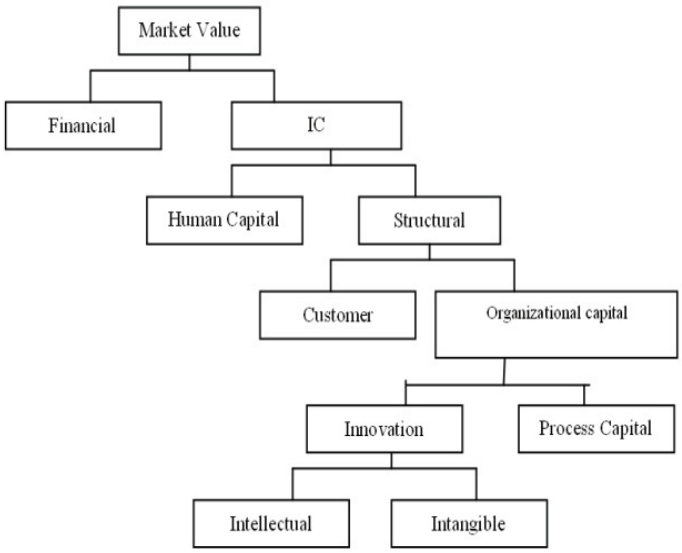

Figure 1. Skandia Model

Source: Roos et al., 1997

Since the start of the Skandia model in mid 1990s, the model has been criticized for its failure for not taking into account a major component of intangible value called social capital (McElroy, 2002). Social Capital refers to connections within and between social networks (DeFilippis, 2001). It focuses on the value of relationships between people forming an organization or community which is a core concept in business, economics, political science, and sociology. Social capital can reduce the information transferring cost and promote corporation (Bueno, Salmador, & Rodriguez, 2004). In the late 1990s, the concept gained popularity, by serving as the focus of the World Bank research program (World Bank, 2005)

and has become the main subject of several mainstream books. The following are four main approaches to social capital.

Social Capital Approach	Main Ideas
Economic development theories	Confidence, civic behavior and associativity strengthen the social networks, contributing to the sustainable economic development
Social responsibility and ethics	Social capital expresses the degree of social integration and responsibility with respect to the whole society and its agents and group. It is based on values and attitudes, such as confidence, corporation, safety, principles, ethics, and compromise
Corporate governance	Ethics and corporate governance codes have a positive impact on the creation of social capital, stimulating the solidarity and overcoming market imperfection
IC	Social capital is a component of IC. It is based on a set of values and the subsequent indicators such as confidence, royalty, sincerity, compromise, transparency, solidarity, responsibility, honesty and ethics

Table 1. Main conceptual approaches of social capital

Source: (Bueno, Salmador, & Rodriguez, 2004)

According to Bueno, Salmador, & Rodriguez, (2004) they propose the evolutionary IC model that had been modified with social capital (figure 2). The model is based on three main intellectual capital components which are human capital, structure capital, and relational capital. The researchers pay special attention to the relational capital. The relational capital consists of business capital and social capital. Social capital consists of social integration capital refers to the relationship between organization and its stakeholders and social innovation capital refers to the set of process and relationship that initiate the innovation (McElroy, 2001). In addition, Bueno, Salmador, & Rodriguez, (2004) also categorize social capital into six areas which are “first, solidarity and social cohesion; second, economic development of the environment; third, commitments of efficient corporate governance; forth, commitments acquired with the scientific and technological development; fifth environmental protection; and sixth defense of cultural and artistic heritage”. Thus, IC process can be applied not only to the business domain, but also to the social domain; in particular to the intangible traditional knowledge.

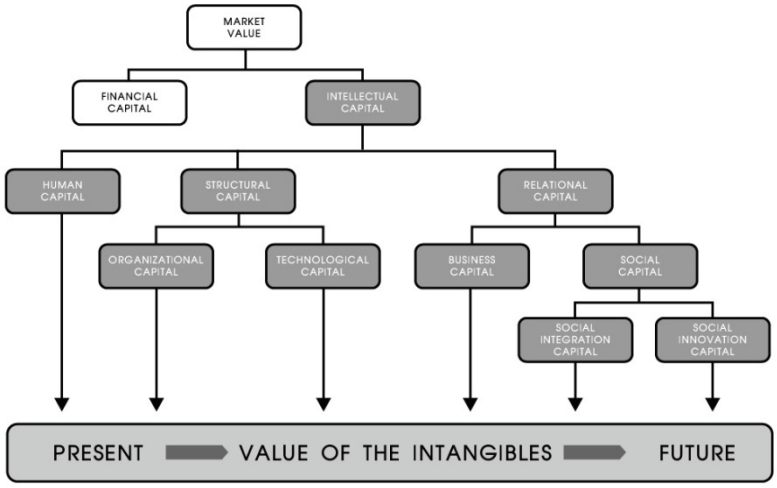

Figure 2. Evolutionary intellectual capital model

Source: Bueno, Salmador, & Rodriguez, (2004)

The case study in this paper explores the IC process that illustrates its practical and pragmatic approach which offer a bridge between the conceptual thinking and practical approach provide a basis for practical tools and methodology for developing, implementing strategy to manage community traditional knowledge.

RESEARCH FRAMEWORK

The research framework is to study the implementation of an intellectual capital system to the Mea-hiya community in Chiang Mai, Thailand by using an intellectual capital process model. The research has been identified through exploratory action research conducted in co-operation with Mea-hiya community cultural council. The research is conducted by using qualitative methods such as documentary research, semi-structured interviews, observations, participatory observations, and focus groups. The target samples interviewed have a direct connection or relationship with community traditional knowledge and its significance. The theme for the semi-structured interview questions was created from literature review. A pre-test of the questions examined to four target samples for adjustment. After the interviews, transcriptions of the interview were made as soon as possible. Data analysis of this research is based on qualitative approach. The content analysis and thematic extraction are used. The documents and the data form interviewees shall be transcribed and analyzed. All text is read line by line and marked margin note. The knowledge & opinion from the participants is analyzed and given systematic coding. The potential themes are identified by grouping examples from the text and then the text is categorized and termed.

The intellectual capital process model is the suggested means for the management of community traditional knowledge toward a local community-based organizational paradigm. A four step-approach (Figure 5) aimed at successful acquisition of the proposed model is

recommended. The design criteria for the community cultural management process model required it to include the following element:

Stakeholders' identification is the first step of the process. Once the list is complete, it is then analyzed by consultation continuum (Bridgman & Davis, 2004) as analyzing tools. The second step is a creation of strategies. The stakeholders' needs and expectations of community traditional knowledge would be the strategy of the community cultural council. Then the needs and expectations are listed and prioritized as strategies. The third step is to translate stakeholders' strategies into action plans which are indicated as key success factors. The needs and expectations found in the previous step must be used to identify the Key Success Factors (KSFs). The final step of the process is to measure the achievement of each KSF by putting indicators that reflect its purpose. Appropriate indicators can be selected carefully by the stakeholders if they indentify the true essence of the KSFs. Rarely does only one proxy provide an accurate measure. Most cases more than one indicator is needed to get a clear and correct picture (Roos et al., 1997).

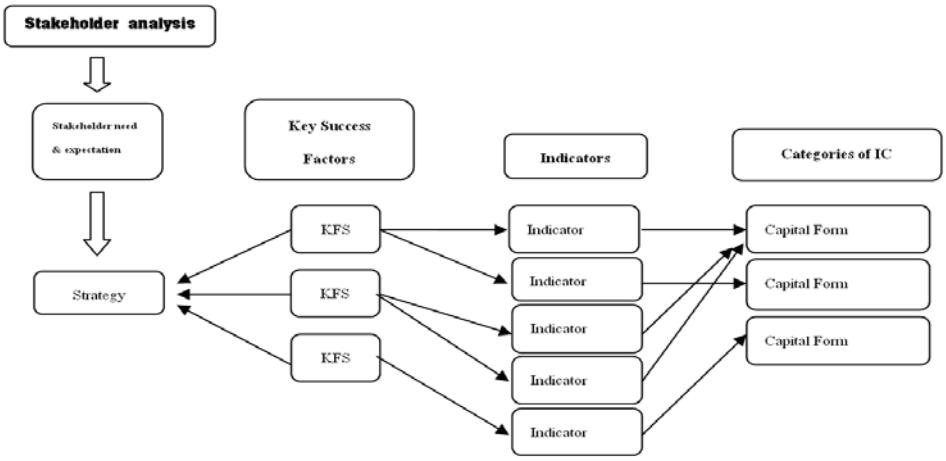

Figure 3. Community Cultural Management Process Model

The case study: The Mea-hiya Community

The Mea-hiya community is located in the Chiang Mai province. Mea-hiya is an urban community with a population of 16,683 (Mea-hiya municipality, 2007) located at 15 kilometers in the southern area of Chiang Mai. The Mea-hiyas are the original Lour tribe community with more than 700 years of history. Their long history creates a fertilization of traditional knowledge which is considered as the cultural heritage of the community.

Since the community is very close to the Chiang Mai province (the second biggest city in Thailand), the Mea-hiyas have rapidly developed in the economic side. In 1990, the main road was built pass through the center of the community. This caused some major changes in the area. Modern trade centers have started a business of selling a huge selection of household goods. All of a sudden, the Mea-hiyas have become a part of the urban city. People from the outside started moving to live and work in the community. The community

has now become more dependent on the outside market and on outside knowledge. The third wave of development has hit the Mea-hiyas continuously and effectively; therefore, the way of life in the Mea-hiya community has changed tremendously..

All these changes have affected the Mea-hiyas' traditional knowledge. The term of occupation has changed when urban growth draws people to urban work. Agriculture which was considered the main profession had suddenly vanished. The way of thinking, behaving and believing is so much different now when it is compared to the pastSome cultural ritual like the Tan Loua Pha Joew festival have now vanished because it does not fit in their way of life anymore. Some cultural ritual performances have changed and are different from the way their ancestors performed because the community does not have a standard reference as a guideline to perform a ritual correctly. Changing the way to perform causes a misunderstanding of the meaning of the ritual. This might also lead to others following in the wrong direction. Moreover, the Mea-hiya community had often at times experienced a big misunderstanding issue. One of the unique rituals called Leang-Dong which has been performed in Mea-hiya for hundreds of year was disseminated to the public by the outside media in 2007. Without an explanation of the reasons behind the ritual, the story caused a stir and was followed by some heavy negative criticism. The central government also came to investigate the incident and the community had to report in clarifying their action. This incident destroyed the community's reputation badly.

FINDINGS

From the observation and document research

The research found that The Mea-hiya community founded a cultural council to manage their traditional knowledge. The cultural council is supported by their local government (man, money and material). The council objectives are to formulate policies and support cultural activities (Mea-hiya Cultural Council Const. Sec 6). However, there are some flaws that should be mentioned. As for a start, the local government has a high influence to manage cultural activities because the government staff handles most of the job. The people in the community haven't really participated fully in managing their cultural activities. Second, most of the activities are conducting annual cultural festival and rituals (Mea-hiya Municipality, 2007). The council is missing in the action to conserve, preserve and protect their community knowledge. This shows that the council does not have the precise policies and strategies to provide a systematic way for the community to preserve, transmit, and protect their traditional cultural knowledge.

From the intellectual capital process

Seven key stakeholders are identified. These seven key stakeholders have a high direct relevance to cultural activities in the Mea-hiya community; Local government, cultural council, local leader, temple, school, local philosopher and villager. Table 2 presents the

prioritizing of key stakeholders who are the most important to the community's cultural domain by using consultation continuum (Bridgman & Davis, 2004). The research identifies the local government as having the highest level of participation to the cultural domain of the community. This is due to the fact that the local government has all the resources for supporting and providing for the community. The local government also has a legitimate authority in controlling the community's activities. The second highest stakeholder is the Mea-hiya cultural council. The council's role is to be the central manager of the cultural function within the community. All annual cultural activity is conducted by the cultural council. The local leader and the temple are the next highest stakeholders. These stakeholders are recruiter. They can gather the villagers, call a meeting and assign a job to a person. The next are schools. The schools support the cultural activities by attending meetings, sending students to join the events and sometimes conduct cultural activities for students in the school. Next is the local philosopher who provides consultations and the last one is village who participates in activities.

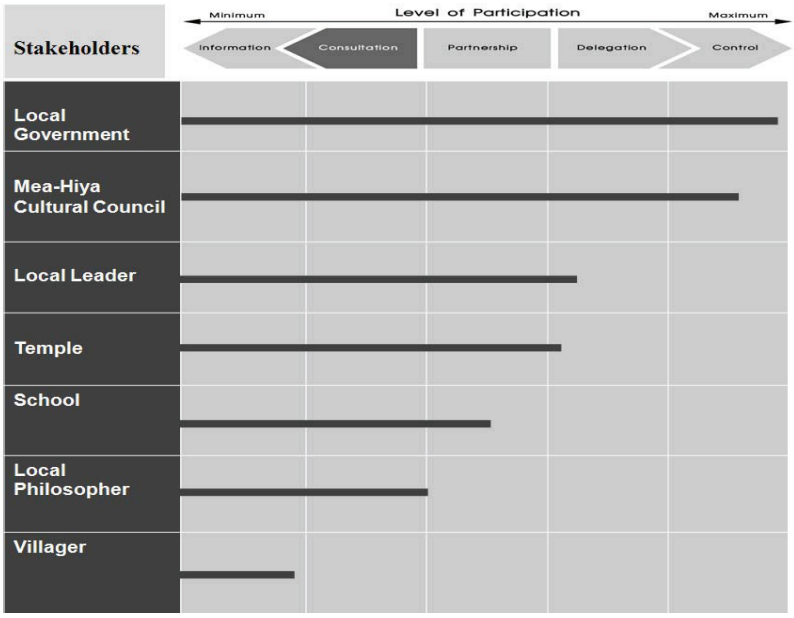

Table 2. level of participation

In order to develop strategies, the stakeholders' need and expectation is needed to verify the representatives of each stakeholder group selected (35 representatives are selected). Nineteen needs and expectations are indentified and categorized into five strategies (Table 3). From the stakeholder's strategies, the focus group is conducted to indentify the strategies' Key Success Factors (KSFs). Ten KSFs are indentified (Table 4). This step provides the needs and expectations to be more quantifiable. As a result, the community's cultural council will have specific actions to reach their goals.

Stakeholders	Needs & Expectations	Stakeholders' strategies
Local Government	• To conserve, support and restore the local culture • Cooperation from citizen (private, household, temple and school)	S1: To conserve, support and restore the local culture
Mea-hiya Cultural Council	• To disseminate the right information to the public • To conserve local culture • To supporting the youth for cultural development	S2: To promote community cooperation
Local Leader	• Cooperation (government, villager, school and temple) • Budget supporting	S3: To focus on children and school for cultural development
Temple	• Cooperation • Children and school are important "for cultural development" • To make cultural inventory from local philosopher	S4: To make traditional knowledge inventory from local philosopher and expertise
Local Philosopher	• To make cultural writings from people with expertise of that specific field • Cooperation • To disseminate the right information to the public	S5: To disseminate the right information to the public
Villager	• Cooperation • Budget supporting • Transfer the cultural knowledge to children	
School	• To make cultural writings from local philosopher and expertise • Local history study • Focus on the youth	

Table 3. Stakeholder's strategies

Stakeholders' strategies	KSFs
S1: To conserve, support and recover the local culture	S1K1: Increase budget
	S1K2: Policy support
	S1K3: Constructing a Mea - hiya history center (for learning)
S2: Community cooperation	S2K1: Strong Networking
	S2K2: Supporting "the Three Generations Center"
S3: To focus on Children and school	S3K1: Local history subject in schools
	S3K2: Create the youth groups & support Activities
S4: To make document from local philosopher and expertise	S4K1: Intensive seminars
	S4K2: Focusing on local philosopher
S5: To disseminate the right information to the public	S5K1: Strong Public relations

Table 4. Key Success Factors

The key stakeholders selected 30 indicators for the ten strategies (Table 4). However, in this case, the stakeholders try to select the easiest and uncomplicated indicators based on their understanding; such as the number of the people who are involved in the activity or the number of seminars. Both examples are easy to count. In addition, the 30 selected indicators are put together and arranged according to the particular outlook of the community intangible capital. Sixteen indicators link to structure capital, twelve indicators link to relational capital and eleven indicators link to human capital (Table 5). Relational Capital and Human Capital were found to be almost equal in importance, but Structure Capital was especially important.

Thus, the direction of Mea-hiya community cultural management is to focus majorly on structure capital. The result concurs with that Structure Capital is the most important part for Mea-hiya community because it serves as an initial stage vehicle to manage their traditional knowledge.

Stakeholders' strategies	KSFs	Indicators
S1: To conserve, support and restore the local culture	S1K1: Increase budget	S1K1I11: The increasing percentage of the local government budget S1K1I22: The amount of money that is supported by local private units
	S1K2: Policy support	S1K2I13: The number of cultural public policy S1K2I24: The strategic planning of the cultural policy S1K2I35: The number of projects/activities which relate to cultural policy
	S1K3: Constructing a Mea - hiya history center (for learning)	S1K3I16: The number of members S1K3I27: The number of media alternatives for studying S1K3I38: The number of subject manual to guide people's learning
S2: To promote community cooperation	S2K1: Strong Networking	S2K1I19: The number of people who involve in the projects/activities. S2K1I210: The number of project/activity that use participation process S2K1I311: The percentage of people that satisfy the projects/activities
	S2K2: Supporting "the Three Generations Center"	S2K2I112: The number of member S2K2I213: The number of people who are involve in the projects/activities. S2K2I314: The number of project that collaborates with all three generations
S3: To focus on Children and school	S3K1: Local history subject in schools	S3K1I115: The number of students that study the cultural subject S3K1I216: The number of subjects in the school curriculum which can integrate cultural concept S3K1I317: The number of local philosophers who are involve in teaching activities
	S3K2: Create the youth groups & support Activities	S3K2I118: The number of children who are involve in the projects/activities S3K2I219: The number of activities S3K2I320: The amount of budget
S4: To make cultural inventory from local philosopher and expertise	S4K1: Intensive seminars	S4K1I121: The number of seminars S4K1I222: The number of cultural subjects and inventories S4K1I323: The number of local philosophers and experts involve in the activities S4K1I424: The number of training program in cultural subject for the villagers
	S4K2: Focusing on local philosopher	S4K2I125: The number of local philosophers that are recognized and admired S4K2I226: A program to look after the well being of local philosophers S4K2I327: The number of cultural inventory that come from local philosopher's knowledge
S5: To disseminate the right information to the public	S5K1: Strong Public relations	S5K1I128: The number of media alternatives partnership S5K1I229: The number of project that collaborates with external organizations S5K1I330: Good image on part of the community

Figure 4. Strategy, Key Success Factor & Indicators

KSFs	Indicators	Capital Focus
S1K1:	S1K1I11: The increasing percentage of the local government budget S1K1I22: The amount of money that is supported by local private units	Human focus
S1K2:	S1K2I13: The number of cultural public policy S1K2I24: The strategic planning of the cultural policy S1K2I35: The number of projects/activities which relate to cultural policy	
S1K3:	S1K3I16: The number of members S1K3I27: The number of media alternatives for studying S1K3I38: The number of subject manual to guide people's learning	
S2K1:	S2K1I19: The number of people who involve in the projects/activities S2K1I210: The number of project/activity that use participation process S2K1I311: The percentage of people that satisfy the projects/activities	Structure focus
S2K2:	S2K2I112: The number of member S2K2I213: The number of people who are involve in the projects/activities S2K2I314: The number of project that collaborates with all three generations	
S3K1:	S3K1I115: The number of students that study the cultural subject S3K1I216: The number of subjects in the school curriculum which can integrate cultural concept S3K1I317: The number of local philosophers who are involve in teaching activities	
S3K2:	S3K2I118: The number of children who are involve in the projects/activities S3K2I219: The number of activities S3K2I320: The amount of budget	
S4K1:	S4K1I121: The number of seminars S4K1I222: The number of cultural subjects and inventories S4K1I323: The number of local philosophers and experts involve in the activities S4K1I424: The number of training program in cultural subject for the villagers	Relational focus
S4K2:	S4K2I125: The number of local philosophers that are recognized and admired S4K2I226: A program to look after the well being of local philosophers S4K2I327: The number of cultural inventory that come from local philosopher's knowledge	
S5K1:	S5K1I128: The number of media alternatives partnership S5K1I229: The number of project that collaborates with external organizations S5K1I330: Good image on part of the community	

Table 5. Mea-hiya Community Capital Focus

DISCUSSION

The intellectual capital process provides many key benefits to Mea-hiya community.

First, the key stakeholders are selected. This means every part of community can participate in the process since the beginning. The process allows the community to focus on the right stakeholders who are the most important to the community's cultural domain (seven key stakeholders are identified for Mea-hiya community). This step provides an opportunity for the community to solve a problem due to the minimum of participation from the people in the community for managing their cultural activities.

Second, the five precise strategies are settled. The research adapts a new idea to the process. Instead of creating strategies from top down, the stakeholders' needs and expectations of community traditional knowledge would be the key element for creating the strategy of the community cultural council. The strategies which are form from the community's stakeholder can respond directly to any situation than the strategy that is formed by the central government. Such an idea includes a plan to conduct activities that will provide the community the preservation, transmission, and protection of their traditional knowledge. According to Riege & Lindsay, (2006), in order to develop strategies and identify related issues, an organization should consult with targeted groups of stakeholders. The consultation provides a better environment to facilitate debate and develop more equitable strategies. The organization needs to have a clear and transparent structure and process to keep stakeholders and their consultation focused (Byrne and Davis, 1998). In addition, the stakeholders can formulate strategies by sharing and participating from the beginning. The action of participation creates a sense of belonging in managing their traditional knowledge for the whole community. The cultural council can initiate actions to respond directly to the stakeholders demands.

Third, by using the intellectual capital process model, the community can put the strategies into practice. For successful implementation of an IC system, there needs to be a linking of the selected IC measures to the strategies (Shulver, Lawrie, & Andersen, 2000). The strategies must be used to identify the Key Success Factors (KSFs). The KSFs are a list of must do activities to achieve the strategic goals. This step provides the needs and expectations to be more quantifiable. As a result, the community's cultural council will have specific actions to reach their goals (ten KSFs are selected). Since the stakeholder's, themselves, formulate the KSFs, they are willing to take on the responsibilities. This step of the process creates some opportunities to fix the problems within an organization using identified strategies which otherwise would be forgotten due to the focus primarily on their short-term goals (Roos et al., 1997).

Fourth, the process strives to be realistic by having a measuring method in the process. This means that the process is more quantifiable. The aims of measuring is to identify the knowledge component of an organization in order to manage them so they can continually improve their performance (Marr, Schiuma, & Neely, 2004). Since this community is dealing

with non-financial data, the difficulty in measuring intangibles is because all indicators selected are proxies for the KSFs (years of experience, hours of training, and etc). However, appropriate indicators can be selected carefully by the stakeholders if they indentify the true essence of the KSFs. Rarely does only one proxy provide an accurate measure. Most cases more than one indicator is needed to get a clear and correct picture (Roos et al., 1997). In addition, the 30 selected indicators are put together and arranged according to the particular outlook of the community intangible capital. Fifteen indicators link to structure capital, twelve indicators link to relational capital and eleven indicators link to human capital (Table 7). Thus, the direction of Mea-hiya community cultural management is to focus majorly on structure capital. The relationship capital and human capital are nearly equal focus.

CONCLUSION

The paper discuss that traditional knowledge disputes have become a worldwide issue and Thailand does not have an appropriate law to protect the nation's tradition knowledge. Consequently, Mea-hiya community does not have an appropriate law to protect traditional knowledge and does not know how to systematically manage their traditional knowledge. To manage the community traditional knowledge systematically and practically, this exploratory action research conducted in co-operation with Mea-hiya community developed the new concept of managing traditional knowledge by implementing an intellectual capital system. Even intellectual capital system is a business oriented concept and seldom applied to non-business approaches, especially in the traditional knowledge area. And even the intellectual capital system is not perfected (can not solve all the problems) but the real added value of the IC system is to provide a new perspective to an organization. The intellectual capital model is a process that put strategy in action. It is grounded in the organization's identity and strategy to understand who you are, and who you want to be. Since the process start with stakeholders analysis that means the real key person in the cultural field are selected and asked. This allows every part of the community participate in the process from the beginning. Key stakeholders' knowledge and opinion is considered to formulate strategies. Thus, the strategies respond directly to the situation in the community. The translation of the strategies into KFSs provides an opportunity to fix the problem that many organizations have. The problem is that the strategies tend to be forgotten by almost everybody in the company because the focus of the organization meeting with their short-term goals. Up to this step, the process is not doing anything out of ordinary. The process of creation of strategy and KFSs are established practices in many academic and practitioner community. The challenging of the process is to measure each KFS. The way to measure the achievement of each KFS is to put indicators to reflect the KFS. The aim of measuring is to identify the knowledge component of organization in order to manage them so they can be turned into continuous performance improvement. This process is practical and quantifiable. Furthermore, during the selection of KFSs and indicators, the stakeholders need to participate and provide their knowledge to generate these matters.

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Exploring the Factors Influencing Knowledge Sharing from the Perspective of Knowledge Flow

Chinho Lin, Institute of Information Management of National Cheng Kung University, Taiwan ROC
Ju-Chuan Wu, Institute of Information Management of National Cheng Kung University, Taiwan ROC
Teresa L. Ju, Dept. of Information Management, Shu-Te University, Taiwan ROC
Andrea CP Liu, Institute of Information Management of National Cheng Kung University, Taiwan ROC
linn@mail.ncku.edu.tw

ABSTRACT

Knowledge management (KM) is deemed an essential activity for business entities to survive or obtain competitive advantages, and the process of knowledge sharing especially affects the performance of KM implementation. However, this always involves varied and complex human behavior, and the interactions among organization members and organizational practices are deeply related to the organizational climate as well as to information technology. Hence, this research is first based on the viewpoint of behavioral science to explore the factors influencing knowledge flow in organizations, and then aims to evaluate the revised CHAT model as a mechanism for detecting potential barriers and relationships among them within. In addition, we verify the research findings by way of questionnaire collection and analysis, and finally present a relatively comprehensive approach and research propositions for academics or practitioners to better manage KM implementations.

Keywords: Knowledge Flow, Knowledge Sharing, Barriers to Knowledge Flow, Knowledge Management, CHAT

INTRODUCTION

Knowledge is a fundamental asset for firms. People bring knowledge and experience to the situation when they address complex, unstructured problems, and as they interact during the process of problem solving, creating, using, and sharing knowledge [1]. Knowledge has been described as information combined with experience, context, interpretation, and reflection [2, 3]. Knowledge is embedded and flows through multiple entities within a firm, including individuals with domain expertise, specific best-known methods, or lessons learned from similar experiences, documents, routines, systems and methods. Increasingly, knowledge is distributed across individuals, teams, and organizations. Therefore, the ability to create, acquire, integrate, and deploy distributed knowledge has emerged as a fundamental organizational capability (Sambamurthy and Subramani 2005; Phusavat, Kess et al. 2008; Soosay and Hyland 2008). Knowledge management is the discipline of enabling individuals in an organization to collectively acquire, share and leverage knowledge to achieve organizational objectives. KM is evolving into a strategically important area, and is closely related to an organization's static substance and dynamic process knowledge [4]. Broadly, it can be viewed as the process by which organizations leverage and extract value from their intellectual or knowledge assets. Effective KM can enhance efficiency and productivity, ultimately help achieve long term corporate goals, and is thus truly a goal-directed and value-added activity [5]. However, KM may achieve nothing without clear goal setting and appropriate methods, since staff interactions and consequently human behavior decide the quality of KM implementations as well as how smoothly the knowledge flows. Due to the current complex and turbulent environment, non-linear relationships, the holistic nature of data, knowledge and wisdom, all of which interact with human behavior [6], need to be

considered when examining KM. In addition, among the existing mechanisms of knowledge delivery and sharing, information technology (IT) is probably the most essential [7, 8], and thus IT-based knowledge management will be discussed further in this study. Knowledge flow is concerned with developing channels or networks between knowledge providers and seekers. In an organization, knowledge flow is fundamentally driven by communication processes and information flows [9]. The mechanisms of knowledge flow can carry, share, and accumulate knowledge when it goes through from one individual to another. In addition, the approach for coordinating the knowledge flow process with the workflow process can provide an appropriate way to model the distributed work process [10], since, in essence, the process and outcome of knowledge flow are mainly affected by human behavior. Extending the idea that knowledge comes from people and their activities, one of the approaches selected as the initial model is the cultural historical activity theory (CHAT) [11]. It emphasizes contextual factors and proposes that human activity is mediated by cultural signs such as: words, tools, and communities, which cause changes in that activity, and thus also affect people's opinions and attitudes. Furthermore, CHAT can maintain a holistic view of the problem and allow for the messiness of context and diversity [12]. Different from previous research, we first focus on the nature of knowledge and KM activities, starting from the human activities literature in social science and then combining different but comprehensive views from academics and practitioners to develop a model for simply, broadly and deeply studying the activities of KM in business entities, especially with regard to knowledge flow. Therefore, the main purposes of this study are as follows.

(1) To evaluate the revised CHAT as a framework for business entities to comprehensively observe and manage knowledge management implementation.

(2) To explore the relevant factors which affect knowledge sharing or transferring as well as the barriers to knowledge flow.

(3) To further discuss the relationship among barriers to knowledge flow and the managerial implications. This is an empirical study to conduct qualitative and quantitative research on knowledge sharing and transferring from the perspective of knowledge flow in organizations. Hence, in section one, the basic concept of the framework for exploring and constructing what and how those relevant factors affect knowledge sharing and integration are demonstrated, with the theoretical framework and related literature reviewed in section two. Section three describes our research methodology for exploring factors influencing knowledge flow based on a revised CHAT model, and then we will further verify and validate the research findings both through qualitative and quantitative analysis. In section four, we discuss the research results and findings, and briefly explain the related managerial implications as well as the limitations of this work.

THEORETICAL FRAMING

Knowledge basically comes from people, and is a complex concept, with a number of factors determining the nature of knowledge creation, management, valuation, and sharing [13]. Since human behavior plays a critical role in knowledge management activities, we first review the social science literature related to human activities and then select the cultural historical activity theory (CHAT) as the initial model for studying the activities of KM. CHAT has been widely used in previous studies on education, information system and knowledge management [12, 14-16]. Different from the rationality and bounded rationality models [17-19], CHAT emphasizes contextual factors and proposes that human activity is mediated by cultural signs such as words, tools, and communities, which cause changes in

that activity, and thus peoples' attitudes and opinions. Consequently, CHAT has four components: subject, object, tool, and community. The four elements influence the outcome of a human activity, and particularly the related mental activities [14]. CHAT motivates analysts to seek out and explain the internal contradictions and socio-cognitive dissonance embedded in collaborative work practices [20], and hence it takes human activity, particularly mental activity, as the basic component in purposeful human work [21]. The fundamental CHAT principle is thus the unity of consciousness and activity, where "the human mind emerges and exists as a special component of human interaction with the environment" [16]. The mind can therefore be analyzed and understood only within the "context" of an activity. The four components of CHAT can be seen in Figure 1. "Subject" refers to the active, cognizing individual or social group with consciousness and will. "Object" refers to that towards which the subject's cognitive or other activity is directed. Not only is the object altered through interaction with the subject, but knowledge develops only through the interaction of the subject and object. An "activity" is undertaken by a human "subject" motivated towards an "object", producing outcomes and mediated by "tools" and "community".

[Take Figure 1 about here]

Insights from the Existing Literature

Knowledge Flow

Knowledge flow is defined as the movement and availability of information; and the literature notes the human conduits of such flows [10, 22]. It is concerned with developing channels or networks between knowledge providers and seekers, and knowledge flow in an organization is fundamentally driven by communication processes and information flows [9]. Moreover, organizational knowledge flows can be greatly facilitated if knowledge is codified, i.e., packaged into formats that allow its transmission to other subunits [23]. In addition, coordinating the knowledge flow process with the workflow process can provide a better way to model the distributed work process [10]. Consequently, to better understand the mechanisms and barriers affecting the outcome of knowledge sharing and knowledge integration, we present the determinants of knowledge flow as follows. In general, knowledge flow is most likely influenced by four factors: the knowledge transferred, the source, the receiver, and the context in which the knowledge flow takes place [9, 24, 25]. Without noting the "context", Zhuge (2002) indicated three crucial attributes of knowledge flow: direction, content and carrier. Bock and Kimfound (2002) found that the expected associations between knowledge sharers and expected contribution to the organization are major determinants of individual attitudes toward knowledge sharing [26]. However, these determinants may become barriers if not applied appropriately. KPMG's survey [27] suggested that the biggest barrier to organizational knowledge usage is a blocked channel between the knowledge provider and seeker. Blockages arise from causes such as temporal limitations, lack of staff motivation and willingness, as well as lack of incentives. Jain et al. (2006) conclude that the strongest barriers are lack of rewards and recognition, lack of time, and lack of formal and informal activities to cultivate knowledge sharing [5]. In addition, a culture that does not provide sufficient support, lack of interaction between knowledge providers and receivers, lack of a sharing system, a physical work environment that restricts knowledge sharing, a lack of trust among staff [28], fear of knowledge being misused by taking unjust credit for it, poor verbal/written communication and interpersonal skills, and inappropriate use of IT systems are all the obstacles to knowledge sharing activities [29]. Dixon (2002) believed that lack of absorptive capacity, the assumption behind the question (i.e. the context), the relationship between knowing and identity, confidence in the source of knowledge and the

suitability of the knowledge for the project are all drivers as well as inhibitors of knowledge sharing [30]. Ndlela and du Toit (2001, 2008) indicated that people related issues, including unwillingness to share knowledge and lack of leadership commitment, as well as time and resource constraints, could be barriers when trying to implement a KM program [31-33]. Synthesizing the related literature reviewed above, we classified the factors influencing of knowledge flow into the following categories:

Knowledge characteristics

Many studies have found that the characteristics of the knowledge being transferred are the most influential factor for effective knowledge flow [34-36]. Casual ambiguity and the unproven nature of the knowledge are two major things which hinder flow. Casual ambiguity emerges when the precise reasons for success or failure in replicating a capability in a new setting cannot be determined. This is common because tacit knowledge is embodied in human skills, and thus it is difficult to measure its marginal contribution. In addition, knowledge without a proven record of past usefulness is also more difficult to transfer [25].

Knowledge sources

Riege concluded that the barriers concerning the sources of knowledge are lack of time, fear of reducing or jeopardize job security, low awareness and realization of the value and benefit of knowledge sharing, poor communication skill, fear of losing the ownership of intellectual property and lack of trust in others [37]. Dixon (2002) indicated that knowledge sharing is a voluntary action. Hence, efficient sharing depends on the willingness of individuals to signal to the organization which knowledge they possess and to share it when requested. However, individuals and teams that have invested resources in building up a specific competence may not be willing to share this knowledge with others unless they are given the right incentives for doing so [13, 30]. On the other hand, Dixon also pointed out that when making decisions based on external knowledge, it is critical for the knowledge receiver to have confidence in the source.

Knowledge receivers

A precondition for the knowledge receiver is that they have sufficient prior related knowledge to assess the value of the new information, (i.e. absorptive capacity) [30, 38], and also not resist using knowledge from outsiders (not-invented-here, or NIH syndrome) [39]. Szulanski (1996) classified the barriers concerning knowledge receivers as lack of motivation, including NIH syndrome, lack of absorptive capacity and lack of retentive capacity [25]. Riege (2005) mentioned that lack of trust in the accuracy and credibility of knowledge due to the source is a barrier to receivers using knowledge from outsiders. In addition, culture, language, technology, discipline and level of experience all have influences on absorptive capacity [30].

Contextual factors

Context is defined as “a wider dynamical process of which the cognition of an individual is only a part” [40]. Nonaka and Konno (1998) tried to define “context” by introducing the concept of “ba”, which is an open space where participants with their own contexts can come and go and the shared context can continuously develop. This space can be physical (e.g. an office or dispersed business space), virtual (e.g. e-mail or a teleconference), mental (e.g. shared experiences, ideas, ideals), or any combination of these [41].

Context helps to determine the features of a practice [42]. Knowing how context emerges and transforms is significant if we want to understand how people create, use and share knowledge. Context has been recognized by many KM researchers as being a crucial component to improve the understanding of knowledge [43]. During problem solving processes, people develop and modify their inter-subjective understanding, and as a consequence of these processes, the context emerges and transforms. In turn, context influences what knowledge people choose to create, use and share, and thus influences what problems can be addressed and how they are solved [1]. Next, we categorize the contextual factors concerning knowledge flow barriers into "the relationships between the knowledge sources and knowledge receivers", "organizational context" and others, which are described in detail as follows:

(1) Relationships between knowledge sources and knowledge receivers Individual perceptions of approachability, credibility and trustworthiness mediate knowledge import and sharing. Lack of contact time, interaction and differences in experience level between knowledge sources and receivers are the barriers to knowledge sharing [37]. Szulanski (1996) found that there are "arduous relationships" between knowledge sources and receivers and the success of such relationships depends to some extent on the ease of communication and on intimacy. In addition, unawareness on both ends of the transfer is another barrier to knowledge sharing, and the larger the organization, the greater this problem is. The relationship herein is this a complex web of interdependent social and organization networks [44].

(2) Organizational context Szulanski (1996) believed that a barren organizational context leads to the stickiness of knowledge transfer [25], while formal structures and systems, sources of coordination and expertise, and the behavior-framing attributes of the organizational context facilitate attempts to transfer knowledge.

Culture and cultural characteristics constitute a key determinant of managerial practices [45], and consequently may have a great impact on the process of knowledge transfer within and among organizations [46]. Brown and Woodland (1999) also noted that organizational culture can be a major barrier to both organizational and individual learning [47, 48]. There are three components of organizational culture that are related to effective knowledge sharing, namely a clear organizational vision and goals, trust, and social networks [49], all of which can exert positive effects on employee knowledge-sharing capacities. Meanwhile, De Long and Fahey (2000) identified four ways in which culture influences the behaviors central to knowledge creation, sharing and use [48]. First, culture, and particularly subcultures, shape assumptions about what knowledge is and which knowledge is worth managing. Second, culture defines the relationships between individual and organizational knowledge, determining who is expected to control specific knowledge, as well as who must share it and who can hoard it. Third, culture creates the context for social interaction that determines how knowledge will be used in particular situations. It represents the rules and practices that determine the environment within which people communicate. Fourth, culture shapes the processes by which new knowledge is created, legitimated, and distributed in an organization. De Long and Fahey (2000) warned that low-trust cultures constrict knowledge flow and suggested that managers develop a strategy and specific interventions to align the firm's culture in support of more effective knowledge use. In addition to organizational structure and culture, time constraints [50, 51], poor organizational incentives [51, 52], legal and policy constraints [53], lack of leadership, low level of co-worker supervision, inadequate company resources, a poor physical work environment, lack of formal and informal spaces to share and the too large size of business units [36, 37, 54-56] also inhibit the collection of

embedded knowledge in a written form.

The mechanisms for knowledge flow basically contain the "tangible" mechanisms, such as telephones, discussion rooms or computer networks, and "intangible" mechanisms, such as unscheduled meetings, informal seminars, or coffee break conversations [63]. Riege (2005) pointed out the potential technological barriers to knowledge sharing involved a lack of integration of IT systems and processes, the unrealistic expectations of employees, lack of compatibility between diverse IT systems, a mismatch with individuals' needs, a lack of employee familiarity and experience with new IT systems, a lack of training regarding such familiarity, and a lack of communication about the advantages of the new IT systems to employees [37]. Drawing from prior discussions, we summarize and classify the relevant factors influencing KM as well as the barriers to knowledge flow in Table 1, using five dimensions based on the CHAT model and Lin's findings [12].
(3) Other contextual factors Doz, Santos et al. (2001) indicated that geographical dispersion, context differentiation and the competitiveness within business units [35, 37, 57] all influence the process of knowledge sharing between units in complex organizations. In addition, a shared language also plays an important role in the knowledge sharing process [58], as people tend to build up their own boundaries, often creating overly technical terminology so that others cannot participate in what they do [59]. Dixon (2002) conducted interviews and found that when sharing knowledge, the knowledge sharer will need to know why the question is being asked as well as the context in which the question is embedded. Moreover, when making decisions, the sharer should further examine how the situation the knowledge provider is describing fits the application that the receiver has in mind [30]. According to Koskinen (2005), knowledge is acquired and transmitted through symbols with an efficiency that will vary depending on the characteristics of the communication channels used for transmission, such as face-to-face, telephone, written personal, written formal and numeric formal. Minimizing the loss of information caused by the use of a single channel requires either the simultaneous activation of several channels of communication [59-61].

(4) Inadequate/ mechanisms Knowledge flow is concerned with developing channels or networks between knowledge providers and seekers, and seems to be the most practical area in knowledge management [9]. KPMG's [27] survey suggested that the biggest barrier to organizational knowledge usage is a blocked channel between providers and seekers. Ruddy (2000) argued that improving knowledge sharing in a meaningful way requires a "delicate marriage of technology with a keen sense of cultural or behavioral awareness". But technology that works effectively in some contexts may fail in others, and the key issue is thus how to choose and implement a suitable technology that provides a close fit between people and the organization [37, 62]

[Take Table 1 about here]

Knowledge Sharing

Knowledge sharing can be defined as activities for transferring or disseminating knowledge from one person, group or organization to another, including both tacit and explicit knowledge [64]. Fernie et al. (2003) believed that explicit knowledge lends itself easily to sharing, while the sharing of tacit knowledge is argued to be of a more complex nature, because it is difficult to extract from the knower [65]. Shin, Holden et al. (2001) regarded knowledge distribution, transformation, dissemination, transference and sharing as all analogous to knowledge sharing with regard to the knowledge management value chain [9]. Some researchers have argued that knowledge sharing is the product of socialization, and is a

process of knowledge creation [13, 65]. From the viewpoint of knowledge-based systems (KBS), Correa da Silva et al. (2002) defined knowledge sharing as "the process of conveying knowledge embedded into one KBS to another" [66]. Shin, Holden et.al. (2001) believed that knowledge sharing is the dyadic exchange of knowledge between source and receiver, and that it is one of the most important and common managerial issues. Balasubramanian et al. (1999) presented a "knowledge mill" framework for describing knowledge management processes-capture, transformation, classification, maintenance, discovery and dissemination. The dissemination process, i.e. sharing, determines how people gain access to the knowledge content, with the objective of making it easy for people to find what they are looking for. Davenport and Prusak (1998) defined knowledge management as a process of capturing, storing, sharing, and leveraging knowledge [2]. Bock and Kim (2002) indicated that sharing knowledge is often unnatural, and people may be reluctant to do so if they think their knowledge is personally valuable and important [26]. Therefore, based the theories of economic and social exchange, they developed a model concerning knowledge-sharing behavior. Economic exchange theory concerns extrinsic benefits, which emphasize rewards and incentive programs, while social exchange theory concerns intrinsic rewards, which engender feelings of personal obligation, gratitude and trust.

CHAT model and knowledge flow

Since CHAT attempts to explain the complexity of human and mental activities, and Hasan and Gould (2001) proposed a sense-making activity model based on CHAT, we regard it as suitable for describing KM activities. Figure 2 presents how the CHAT framework can be applied to sense-making activities. In addition, CHAT has been used to describe the relationship between a subject and an object, which is analogous to the knowledge source and the knowledge receiver in the process of knowledge flow. Therefore, the CHAT framework should be able to provide the structure and substance for this research, while at the same time maintaining a holistic view of the problem and allowing for the messiness of the contexts and diversity of stakeholders' perspectives [12, 14].

[Take Figure 2 about here]

In order to comprehensively frame the theoretical perspectives and assumptions that are available for knowledge flow research, we based our work on the initial idea of cultural historical activity theory [11, 21], and adopted the revised CHAT as our theoretical framework [12]. CHAT allows us to carve the theoretical landscape into five domains: subject, object, tools, community and outcomes, and the domains may contain most of the factors concerning knowledge flow. "Subject" refers to "knowledge source"; "object" refers to "knowledge receiver"; "community" refers to "context", and "tools" refers to "mechanisms". Figure 3 presents how CHAT can be applied to describe knowledge flow determinants.

[Take Figure 3 about here]

RESEARCH METHODOLOGY AND ANALYSIS

To test the proposed research model (i.e. the revised CHAT model), we adopted in-depth and face-to-face interviews for concept building and transcript generating, the survey method for data collection, and then examined our propositions by using a questionnaire with a five-point Likert scale (from "strongly disagree" to "strongly agree"). This research was

exploratory and qualitative in nature, and consisted of two phases. Phase I was the literature review and in-depth interviews to explore the mechanisms and barriers regarding knowledge flow and KM activity under a revised CHAT framework (see Figure 2). In order to further evaluate and comprehensively confirm the propositions from phase I, the questionnaire was used to validate the propositions from phase 1. The research process is shown in Figure 4.

[Take Figure 4 about here]

Research Framework

According to both the theoretical and practical concerns, we explored the factors influential to knowledge flow in business based upon the revised CHAT framework [21] and Szulanski's findings [12, 25]. Although there was a similar study was done by Lin et al. (2008), it only conducted CHAT in a single hospital, where the activities are totally different from those in a business. Thus, we extended the revised CHAT model with some modifications to be suitable for exploring the barriers of knowledge flow in commercial entities and its various activities.

This study not only used the four elements of "subject" ("knowledge source"); "object" ("knowledge receiver"); "community" ("contextual"), and "tool" ("mechanism"), but also adopted the factor of "knowledge sharing and transferring" which was emphasized in Szulanski's work [25] and specified as a vital construct of knowledge flow. The most important assumption of CHAT is that all human and mental activity is mediated by the use of tools and the community in which it occurs [14], and thus in this study we assumed that all the elements of knowledge flow affect the outcome of knowledge sharing and integration. Secondly, knowledge sharing and integration are perceived as an "activity" in the CHAT approach. The research framework is shown in Figure 5.

[Take Figure 5 about here]

Measurement and Data Collection

Phase I Study

We conducted in-depth interviews with the managers of the selected sample companies and got twelve transcripts in total. The size of the participating companies ranged from medium and large-sized manufactures to multinationals, employing workforces of between 450 and 19,000. In addition, all of the firms were selected according to the best practice of KM in Taiwan. The interviews were performed from August 2006 to July 2007. All individual in-depth interviews were face-to-face and lasted for between sixty and ninety minutes, were audio-taped and transcribed verbatim. Observation and informal conversations also constituted an important part of the data collection process. In the process of data-organization, we adjusted the classification framework continuously. If any information was ambiguous or insufficient, we contacted the respondent again to confirm the data. Consequently, three researchers who were familiar with KM implementations conducted the content and context analysis, thoroughly reviewing all the transcripts and classifying statements by themes, and then jointly reviewing each statement. Any disputes about the status of statements were discussed until ideally a consensus was reached.

Phase II Study

In order further evaluate and verify the propositions which were generated by content analysis in Phase I, a questionnaire was developed with each item measured on a five-point Likert scale (from "strongly degree" to "strongly disagree") for further testing [67]. After all of questionnaires were reviewed both by academics and practitioners, 30 samples were selected for a pilot survey preformed from March 20th to April 10th 2008. In order to increase the response rate and reduce the delivery cost, an electric questionnaire was used to collect data from randomly selected listed companies in Taiwan. A One-Sample T-test was used to test the hypothesis (H1: $\mu \geq 3.5$ and H1: $\mu \geq 4$) with a 95% confidence interval (p-value is 0.05) for responses about the mean, where the data are a random sample of independent observations from an underlying normal distribution.

ANALYSIS AND VALIDITY

Results from the Phase I Study and Construct Validity

Based on the results of the face-to-face interviews and qualitative analysis, the related themes are summarized in Table 2. All of them were reviewed at least twice review by three coders and confirmed by the participants in this study. After the discussions with the experts who participated in this research, it was confirmed that the revised CHAT model was suitable for studying the activities of KM implementation. In addition, some other important issues concerning knowledge were uncovered, leading to the development of more research propositions. Lastly, the barriers to knowledge flow were classified into five categories, and the relationships among them are also discovered. After much analysis and discussion, 1,145 themes were chosen, with 862 themes that two or more coders agreed on. As a result, the degree of inter-coder agreement is 75.3%, and the reliability of this research is 85.9%. This also indicates the classification between the coders reveals a consistent viewpoint.

[Take Table 2 about here]

We summarize some the themes and statements regarding the association between barriers to knowledge flow with the material in Table 3, as excerpted from the interviews. It not only shows which barriers affect others, but also suggests additional research propositions for further testing. The casual relationships or the stories behind them are also worth investigating in order to observe and manage KM activities. We present the well-ranked factors in Table 2 and the associations among barriers in Table 3 as the proposed research propositions (as well as the questionnaire's measurement items, shown in Table 4) to further test in Phase II.

[Take Table 3 about here]

Results from Phase II and Construct Validity

A total of 109 usable responses were returned, yielding an effective response rate of 60.55%. In this phase, the reliability (internal consistency) and construct validity were established by Cronbach's α method and item-total correlation. As shown in Table 4, all of the questions were found to be highly reliable, with a Cronbach's α of greater than 0.7 [68, 69]. As seen in Table 5, the Cronbach's α of the questionnaire was 0.887, which means not only did the questionnaire have high consistency and that the answers were highly reliable, but also that the questionnaire did not need any item to be changed to increase the reliability. The item-total correlation was used to measure criterion-related validity. The correlation between each of the remaining 20 items and their sum was calculated, and is shown in Table 4. Nunally

(1978) recommended that items with Item-Total Correlations (ITC) below 0.4 should be excluded [68, 70], and thus items 5 and 6 were dropped from further propositions testing. In addition, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Barlett's sphericity test were conducted to verify the questionnaire. A KMO value greater than 0.7 is viewed as acceptable [71], and Table 5 shows that the questionnaire achieved this and that the results of Barlett's sphericity test were also significant (p-value = .000). Excluding items 5 and 6, the results show the questionnaire was suitable and representative for subsequent proposition testing. In addition, a five-point Likert scale was employed in the questionnaire to measure the degree of acceptance of the propositions. A t-test for dependent samples helped us to take advantage of one specific type of design in which an important source of within-group variation (which can be considered an error) can be easily identified and excluded from the analysis [72]. Consequently, it is significant when the mean of the degree is more than 3.5 or 4. In this study, we used a one-sample t-test with test values of both 3.5 and 4 (H1: $\mu \geq 3.5$ and H1: $\mu \geq 4$, one-tailed test) with a 95% confidence level (p-value at 0.05) to check the significance of the propositions. The test results are shown in Table 6, and comparing test values 3.5 and 4, most of the items, excluding 2 and 7, were marginally accepted when the test value was 3.5. Furthermore, for strict evaluation, there are five items, 3, 14, 16, 17 and 20, which were acceptable when the test value was 4. This shows that the importance of these five items, and thus they are worthy research propositions.

[Take Table 6 about here]

DISCUSSION, IMPLICATIONS, AND LIMITATIONS

Discussion

KM ensures that knowledge flow can take place across organizational or geographical boundaries [73]. The interaction between the business insiders and data miner is actually a knowledge sharing process, and the content is the knowledge of the organization [8]. To ensure the good practice of KM, it is important to find the boundaries and barriers which exist in the knowledge flow, in order for managers to take remedial steps to improve the situation and let the knowledge flow more freely. As our first step, we selected the revised CHAT as appropriate for exploring barriers to knowledge flow, and those barriers can be classified into five categories, namely: characteristics, source barriers, receivers, contexts, and mechanisms. Different from the previous research, which only focused on a single hospital, we broadened the scope to businesses to explore the barriers to knowledge flow and their causes and associations within organizations. We found, not surprisingly, that the KM related activities were more complex and various in businesses than in a single hospital, and the revised CHAT model was also confirmed as a suitable tool for managers to observe and manage KM activities in their organization. More surprisingly, we found that the most important and common barriers may be quite different in different organizations, and that it is thus essential to comprehensively understand the nature of KM activity and the association among barriers in a business. In this way, the research findings were separated into two aspects for detailed discussion. One of these was about the nature of the barriers to knowledge flow. After the phase II study, we found that it is reasonable to combine the dimensions of source, receiver and context as a single dimension, organizational climate, and thus the five dimensions can be reduced to three: knowledge characteristics, organizational climate, and mechanism. The second area for detailed discussion was about the associations among barriers, and the results are as follows:

(1) As shown in Table 2, the organizational structure is the top ranked factor, and is thus the most important factor for KM implementation.

(2) Extending the preliminary viewpoint, as shown in Tables 2 and 4, the organizational climate of knowledge sharing is the most general and crucial point for knowledge flow, and includes three dimensions - knowledge source, knowledge receiver, and contextual factors, and this also fits our initial assumption and the proposed revised CHAT model, which emphasized human behavior. Lazarove and Tarique (2005) argued that effective knowledge sharing occurs when there is a fit between individual readiness to share knowledge and organizational receptivity to knowledge. The intention and attitude of knowledge receivers also influences the outcome of such sharing, and thus the practice is closely associated with "people" [74, 75]. In addition, Gottschalk (2006) suggested developing an organizational culture (ranking third in Table 3) that facilitates and rewards knowledge sharing. Empirical studies have also shown that the greater the anticipated reciprocal relationships are, the more favorable the attitude toward knowledge sharing will be [76]. As Gee-Woo et al. [77] noted, effective knowledge sharing cannot be forced or mandated, and firms desiring
to institutionalize knowledge-sharing behaviors must foster an appropriate work context.

(3) With regard to the characteristic of knowledge, the factor of ambiguity is ranked second (as shown in Table 2). The ambiguity of knowledge itself is the critical barrier for knowledge sharing or transferring, and if the knowledge itself is unproven it may also impeded

knowledge flow. The characteristics of the knowledge transferred also affect the outcome of knowledge sharing, and it should be both useful and applicable. Finally, when knowledge is codified and stored, sharing is better facilitated [78].

(4) With regard to the mechanism of knowledge flow, the tangible mechanism: IT is obviously important but not crucial for knowledge implementations. Hence, how sophisticated the information technology itself is may not be as important as whether or not most members in an organization realize the advantages of both IT and KM... Another important factor about the mechanism is that integration of IT and processes, which also echoes previous research that saw IT and process reengineering, i.e. maintaining high-quality information technology, as essential as organizations move toward a "system of systems" and a "team of teams" [79, 80]. As Bhattacherjee mentioned (2006), IT managers can benefit from knowing what influence processes can be used to motivate organizational members' acceptance of IT and under what circumstances these processes are likely to succeed or fail. The tool-based mechanism and integrative are the major approaches to enhance employee knowledge sharing. It has also been noted that the flexibility inherent in an inquiring system is particularly useful for information acquisition, knowledge sharing, and organizational learning.

(5) There are certain factors that most people intuitively think are important, but which may not really be so in practice, such as knowledge being proven or not, rewards, knowledge receiver's retentive capacity, lack of contact time and interaction, unawareness of knowledge, lack of leadership, different language, technological terminology, and so on. For example, especially, uncertain and changing environment requires knowledge management activities that place more emphasis on the cognition of most members around their chief goals and less emphasis on leadership in an organization, these cognitive factors are related to the mental maps of individuals and organizational decision makers [79] Finally, according to the discussion and findings from phases I and II, the most relevant important factors are: poor

communication skills, difficult relationships between sources and receivers, lack of learning culture, poor organization structure, and lack of integration of IT systems and processes, leading to the following research propositions (see table 6):

Proposition 1: It's hard to express knowledge clearly if the knowledge providers' communication skills are poor. Proposition 2: Difficult relationships among knowledge providers and receivers may affect knowledge sharing and flowing. Proposition 3: Lack of learning culture may deter knowledge sharing and flowing. Proposition 4: The structure of an organization may deter the coordination of both knowledge source and receiver and thus further deter knowledge sharing and flowing. Proposition 5: Lack integration of IT systems and processes may deter knowledge sharing and flowing.

Managerial Implications

It is important that KM researchers be aware of, understand, and build upon the work in the existing literature. However, the previous research generally focused on exploring the factors related to success, while it may now be more valuable and helpful to have a model that takes a holistic view and aims to find the relevant factors which can detect the needs of an organization and assist managers in KM implementation. Thus, there is no optimum approach to KM implementation, but it is possible to develop an appropriate approach if there is a suitable model for observing KM activities, such as the revised CHAT framework and its relevant factors of knowledge flow. In addition, we also presented a discussion of KM activities knowledge flow barriers based on a review, interpretation, and synthesis of a broad range of the relevant literature. Knowledge may be tacit and explicit, it can refer to an object, a cognitive state, or a capability, and may reside in individuals or groups [81]; notably, KM activities involve a diverse set of behaviors. Different from the other management activities such as MIS, KM focuses more on human behavior and the organizational climate for its implementation [77], it strongly emphasis the comprehensive atmosphere of sharing and learning culture in an organization. The organizational climate is actually dynamic in nature, and teeming with the interactions among people and the organization. In short, KM is a human intensive and workforce oriented managerial activity. While leadership is crucial for management activities in any kind of organization, in KM it is not possible to rely only on a few leaders. The coordination with and understanding of most of the workforce is more important and relevant than leadership. Hence, in this research, we can infer that the revised CHAT model is suitable for KM implementation. It can not only be broadly applied to detect the barriers of knowledge flow, and can also help observe the relationship among barriers and search for particular solutions in different situations, but it is also useful for managers aiming to dynamically manage their KM activities. The research results reasonably confirm the propositions that we initially put forward, and showed the barriers which negatively affect knowledge sharing, thus implying that addressing these issues will enhance the performance of KM.

Limitations and Further Work

From the observation during the research period, although we found the empirical results do support the proposed revised CHAT model, however, there are some limitations or challenges worth noting. First of all, due to the exploratory nature of this study, the scales developed and used are necessarily experimental and the data is limited, and thus we regard this research as an illustration of theoretical ideas rather than as a definitive test. Secondly, the face-to-face interviews and transcriptions were very time-consuming, and therefore were limited to either small numbers of participants or long-term observations, which is the main

reason why qualitative and qualitative methods were combined to raise the reliability and validity in this research. Finally, the factors may be incomplete and unsuitable for any commercial organizations. In addition, Hsiao et al. [82] mentioned that the rapid pace of innovation outdates knowledge so quickly that documenting it is of limited value. Furthermore, the different national cultural norms may shape employee's attitudes, behaviors and motivation, which may pose challenges for managers of international organizations [83, 84]. Furthermore, there are some related issues worth further study, such as whether the CHAT model can be extended to the study of "organizational performance", since the associations between KM and organizational performance is what managers care about, but this has not yet been explored in the literature. Another area for future study is to replace the constructs of knowledge sharing and knowledge integration with other KM functions such as knowledge acquisition, knowledge storage.

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THE RELATIONSHIP BETWEEN SOCIAL CAPITAL, ORGANIZATIONAL LEARNING, KNOWLEDGE INTEGRATION MECHANISM, AND HUMAN CAPITAL: A CONCEPTUAL FRAMEWORK

Ru-Jen Lin, Lunghwa University of Science and Technology, Taiwan
rjlin@mail.lhu.edu.tw

ABSTRACT

In the era of knowledge economics, human resource capital is a vital strategic asset in business activity. How to utilize social capital to strengthen human resource capital is one of urgent research issues of the contemporary human resource management field. However, human resource management research has so far ignored the mediating role of organizational learning and knowledge integration mechanism in the research model regarding the relationship between social capital and human capital. In this study, we employ organizational learning and knowledge management mechanism as mediating variables to explore the impact of social capital on human capital. We propose to sample the first three thousands manufacturers of the Commonwealth through the confirmatory factor analysis, structure equation modeling (SEM), and hierarchical regression modeling statistics approaches. The relationships among social capital, organizational learning, knowledge integration mechanism, and human capital will be examined, and the mediator impact of organizational learning and knowledge integration mechanism on the causal relationship between social capital and human capital will be verified.

Keywords: human capital, organizational learning, knowledge integration mechanism, social capital

INTRODUCTION

In the era of knowledge economics, the most important strategic resources in an organization are the intangible assets of human capital and social capital which can create and sustain a market advantage (Barney, 1991; McEvily and Marcus, 2005; McEvily and Zaheer, 1999). Social capital is defined as the embedded ties and relationship structure through trust and reciprocity between network members that they are willing to share the information and resources to acquire new knowledge and complementary assets (Dyer and Hatch, 2006). Based on the trust among the customer, supplier, and the partner relationship, the effects of embedded ties enhance the capability of new product innovation. Drucker (1992) indicated

that post-capitalist society is the era of knowledge economics and knowledge society. Human capital gradually increases the competitive advantage and plays a critical role in value creation for an organization. Adler (1988) and Reich (1991) assert that the importance of human capital is an efficient management and a kind of the equity asset in an organization. Recently, facing dynamic competition and radical technology change, managers have recognized that how to strengthen social capital and human capital is a vital strategic issue for human capital management decisions. Wang and Chang (2005) find that human capital directly affects innovation and further influence performance. Therefore, management should put the most effort on human capital.

According to most of organizational learning literature, the major discussion of social capital and human capital focused on the two main issues: (1) to investigate the effects of social capital and human capital on the competitive advantage; several empirical studies have examined the positive contribution of social capital and human capital on innovation performance, financial performance, and market performance (e.g., Capaldo, 2007; McEvily and Marcus, 2005; Subramaniam and Youndt, 2005); and (2) to investigate the effect of social capital on human capital; the firms enable to enhance their human capital effectively through a good external embedded ties relationship. Numerous studies advocate that social capital enriches employees' knowledge by internal and external network relationships (e.g., Colemen, 1988; Forgensen, 2004; Martinez-Torres, 2006; Reed et al., 2006; Wu et al., 2006).

However, how to use social capital to strengthen human resource capital is one of the imperative research issues in the contemporary human resource management (HRM). Human resource management research has so far ignored the mediating role (the contingency factor) of organizational learning and knowledge integration mechanisms in the research model regarding the relationship between social capital and human capital. From the standpoint of the dynamic environment, firms acquire knowledge through external social capital and transform employees' knowledge effectively which is largely dependent on the organizational learning (Lane and Lubatkin, 1998; Zahra and George, 2002). And knowledge integration makes the information and skills gained from internal and external expansion activities and integral component of the routines that guide the firm's future strategic actions (Teece et al., 1987). Based on this theoretical viewpoint, social capital exhibits the contribution of human capital. However, consideration of organizational learning as a mediator is neglected. Therefore, based on the dynamic capability view, we consider there is not only direct influence between social capital and human capital, but also influential mediators of organizational learning and knowledge integration mechanism. The reason for considering knowledge integration mechanism as a mediator in this study is that knowledge integration mechanism is a key element affecting all the internal and external knowledge integration

from the organizational employees (Luigi et al., 2007) as well as a direct influence on human capital. The purpose of this study is to explore the impact of social capital on human capital and employ organizational learning and knowledge integration mechanism as mediating variables.

LITERATUR REVIEW

Social Capital

In 1970, sociologists addressed the idea that social capital elaborated embedded relationships by the leverage of mutual trust and information exchange to create and strengthen individual wealth and social assets (Burt, 1997). After 1990, numerous scholars of human resource management or strategic management treated social capital as the sum of intellectual capital and competitive advantage (Chung et al., 2000; McEvily and Zaheer, 1999; Uzzi, 1996). Social capital originally referred to the relational resources, knowledge embedded, and utilized by interactions among individuals and their network of interrelationships (Loury, 1977; Nahapiet and Ghoshal, 1998). In this study, social capital indicates that network groups identified with the norms of embedded ties, common vision, and mutual benefit to apply embedded ties to share their information and resources to acquire new knowledge and complementary assets (Dyer and Hatch, 2006; Prabhu et al., 2005). This research extends Inkpen and Tsang (2005) and Nahapiet and Ghoshal (1998)'s perspectives to present trust, embedded ties, and cognition as the dimensions of social capital.

1. *Trust*

   Mayer et al. (1995) claim that trust has been viewed as an aspect of expectation and cognitive resources. When the two parties begin to trust each other based on the antecedent of mutual economic advantage and fair trade, then they are more willing to share their resources and solve their problems without worrying that they will be taken advantage of by the other party. Thus, trust implies the exchange or combination of resources to create values for network groups (Parkhe, 1998; Kale et al., 2000).

2. *Embedded Ties*

   According to the view of Gulati (1999) and McEvily and Marcus (2005), organizations facilitate embedded ties by encouraging interactions, reciprocity, information sharing, and join problem-solving in groups and networks. Several scholars also assert that the strong ties possessed by long-term cooperation among network members enable organizations reinforce their innovation capabilities (Larson, 1992; Uzzi, 1997). Similarly, primary firms have a better network system, obtain more abundant and various knowledge resource and competitive advantage (Capaldo, 2007; Nahapiet and Ghoshal, 1998).

3. *Cognition*

   Cognition is embodied in attributes like common beliefs, goals, and vision that facilitate a

common understanding of collective goals and proper ways of acting in a social system. These attributes of cognition promote individual and group actions benefiting the whole organization as well as an imperative dimension of social capital (Adler and Kwon, 2002).

Organizational Learning

Previous empirical studies regarding organizational learning focused on the results of organizational learning activities (Argyris and Schon, 1978; Senge, 1990). According to human resource management, organizational learning is based on the process of employee individual learning in the organization internally. Firms also recognize external environment change and adopt all kinds of operational knowledge modification to sustain business. In this study, organizational learning is defined as the process by which firms store and transfer employee individual experiences in databases through employee internal and external learning and experience storage in order to enhance the innovation performance (Bontis et al., 2002; Huber, 1991; Grant, 1996).

Huber (1991) and Crossan et al. (1999) develop four constructs related to organizational learning: knowledge acquisition; information dissemination; information interpretation; and application. Firms acquire knowledge from external different sources and integrate knowledge. Consequently, they would transform into new information or experience which increases their employees' knowledge and strengthen their innovation performance (Kogut and Zauder, 1992; Inkpen and Dinur, 1998; Yeung et al., 2007). Finally, firms conducting organizational learning would perform better in assimilation, integration, and application of knowledge in terms of absorptive knowledge (Cohen and Levinthal, 1990; Smith, 1995). Several scholars measure the integration of organizational knowledge from internal and external information and sources. Internal integration is the capability to focus on higher level of integration processes for extensive coordination between different specialized departments within an organization. On the other hand, external integration is the capability to link information and knowledge from their suppliers, customers, join venture partners, or external sources (Iansiti and Clark, 1994; Petroni, 1996). Knowledge application is the capability to apply the knowledge to modify the strategy, resolve problem, and improve performance within an organization (Gold et al., 2001).

To summarize the above ideas, knowledge assimilation, knowledge integration, and knowledge application are three dimensions of knowledge learning. In our study, we treat knowledge learning as mediating variables for the relationship between social capital and human capital.

Knowledge Integration Mechanism

Knowledge integration is defined as the process by which managers determine what has been learned, evaluate its potential importance in which the new knowledge can be used (Olson et al., 1995; Zahra et al., 2000). Therefore, knowledge integration mechanism is defined as the process of searching for and transferring knowledge trough the inter-department knowledge acquisition, analysis, interpretation, and integration (Olson et al., 1995; Zahra et al., 2002). In general, the structure and process focus on the actions taken to achieve functional integration (Griffin and Hauser, 1996). However, knowledge can be integrated formally or informally (Grant, 1996). In this study, we adopt Zahra et al. (2000) suggestions from formal integration perspective to define it as the process by which knowledge have gained from internal and external expansion.

To summarize the previous ideas, this study identified four dimensions of knowledge integration mechanism with knowledge acquirement, analysis, transmission, and integration.

Human Capital

Subramaniam and Youndt (2005) define human capital as the knowledge, skills, and abilities owned and utilized by individuals. Human capital represents the knowledge, skills, experience and abilities employees possess that bring unique and strategic value to firms (Barney, 1991; Ulrich and Lake, 1991). Generally, human capital usually focuses on education and training to improve their skills and experience in order to increase production performance (Becker, 1976; Schultz, 1996; Parnes, 1984). Firms may internalize employment and build employee skills through education and training; they may also externalize employment by outsourcing agents (Rousseau, 1995). The potential benefits of internalize employment encompass stable the firm's stock of skills and capabilities (Pfeffer and Baron, 1988), better coordination and control (John and Hill, 1988). Externalizing employment may provide organization with more options in both the number and types of workers used (Pfeffer and Baron, 1988; Tsui et al., 1995).

Snell and Dean (1992) assert that human capital can be influenced by massive sources of the firm's unique cultures and strategies. In the resource-based view, human resource practices that are unique, value, rare and useful can provide competitive advantages (Khatri, 2000). Therefore, the strategic value and uniqueness of human capital function refers to employee's knowledge, skills, and experience enable a firm to enact strategies that improve the operational efficiency and effectiveness, exploit market opportunities, and/or neutralize potential threats (Barney, 1991; Ulrich and Lake, 1991; Lepak and Snell, 2002).

Based on Subramaniam and Youndt (2005), Barney (1991), and Ulrich and Lake's (1991)

works, this study identified five dimensions of human capital with employee skills, knowledge, experience, strategic value, and uniqueness.

HYPOTHESES DEVELOPMENT

Social Capital and Organizational Learning

Regarding the relationship of trust in social capital and organizational learning, Burt (1982) indicated that a high trust will benefit firms to acquire diverse knowledge and information from embedded ties. Smith et al. (2005) also indicated when firms acquire more diverse external knowledge which will enhance all employees to absorb, integrate and apply new knowledge learning capability. Garcia-Morales and Llorens-Montes (2006) and Senge (1990) indicated that network members in high trust relationship facilitate individual absorbing and applying external knowledge to fit environmental dynamic changes. Similarly, network members embedding in a high trust will reduce barriers of sharing and communicating information and facilitate inter-firm knowledge transfer, absorption and application to enhance organizational learning effects (Dyer and Singh, 1998; Gulati, 1999).

Concerning networking in social capital and organizational learning, few scholars believe that strong tie networks are likely to be largely redundant network mechanism that detracts from organizational learning; but numerous scholars suppose that strong tie networks are likely to facilitate knowledge sharing and better interaction to strengthen organizational learning (Burt, 1992). Clark (1989) found that good networking between suppliers and manufacturers in Japan auto industry makes the centre automaker proactively willing to assist their suppliers in improving product quality and solving problem to effectively promote suppliers' knowledge integration and application capability (Dyer and Hatch, 2006). Several customer relationship management studies have shown that firms utilize information technology to establish embedded ties with primary customers that promptly help it to acquire more multi-market and technological information to stimulate knowledge transfer (Payne and Frow, 2000).

Referring to the dimension of cognition in social capital and organizational learning, network members possess common beliefs, goals, and vision that will create the culture of joint problem-solving. Clark (1989) indicated that suppliers who join in early new product development with their manufacturers will facilitate mutual knowledge learning through processes of join solving product quality and productive problems. Similarly, Ritter and Walter (2003) investigated customer involvement in the customer relationship management and indicated that primary customer actively participates in the process of early new product development and join product problem-solving in the market position, the manufacturer will

effectively cumulate the absorptive and applicative market knowledge and capability. In addition, Kale et al. (2000) empirical study showed that alliance partners enrich their technology knowledge by join problem-solving in development processes which enable to create patent assets. Based on these ideas, we construct the following hypothesis.

H_1: Trust, network ties and cognition of social capital has positive influence on organizational learning.

Social Capital and Knowledge Integration Mechanism

Knowledge integration is defined as the process of searching for and transferring knowledge trough inter-department knowledge acquisition, analysis, interpretation, and integration (Olson et al., 1995; Zahra et al., 2002). In order to ascertain the value of knowledge interpretation, the importance of new knowledge, and the capability of knowledge integration, firms must actively drive knowledge integration mechanism through efficient processes and structures in acquiring knowledge from high trust networks (Zahra and Nielson, 2002). Additionally, network members who realize the importance of high trust and common belief and objective may actively participate in all kinds of associations for knowledge exchange and information sharing (Frank and Richard, 2000; MacEvily and Zaheer, 1999). Firms possess a knowledge foundation more diverse and broad and will reconstruct varied knowledge elements for creating the new market opportunity (Kogut and Zander, 1992). Therefore, managers urge to develop knowledge integration mechanism to promote knowledge absorbable and applying capabilities (Galunic and Rodan, 1998).

Dyer and Hatch (2006) indicated that firms develop knowledge specificity by establishing network relation-specific between firms and primary suppliers or customers. However, knowledge specificity is embedded in some specific domains of experienced employees and obstructs knowledge reconstruction and transfer (Subramani and Venkatraman, 2003; Galunic and Rodan, 1998). Therefore, firms actively impel knowledge integration mechanism through experienced employee specific knowledge to enrich knowledge transfer and transmission (Luigi and Atuahene-Gima, 2007). Based on the discussion above, we propose the following hypothesis:

H_2: Trust, network ties and cognition of social capital has positive influence on knowledge integration mechanism.

Organizational Learning and Human Capital

Human capital is defined as employee skill, experience, knowledge and competence conducting economic activities in an organization to create both strategic value and

uniqueness in order to increase productivity (Lepak and Snell, 1999; Snell and Dean, 1992; Subramaniam and Youndt, 2005), here strategic value enables improved efficiency and effectiveness, exploit market opportunities, and neutralization of potential threats (Barney, 1991; Ulrich and Lake, 1991; Lepak and Snell, 2002). Regarding the relationship between organizational learning and human capital, Cohen and Levinthal (1990) argue that value judgment, assimilation, and commercial application from external knowledge are critical to accumulate the employees' knowledge, experience, and capability in an organization. Leonard-Barton (1992) and Itami (1987) emphasize that the employees' absorption through internal and external knowledge integration and sustained product development will effectively promote knowledge value and technological uniqueness which are the intangible assets in an organization.

Bontis and Fitz-enz (2002) propose that knowledge and technology for improving management and product innovation by in-house employees will gradually accumulate employee personal experience and knowledge storage. In other words, there are a positive influence between knowledge application and human capital in an organization. Based on the above discussions, we construct the following hypothesis.

H_3: Organizational learning has positive influence on human capital.

Knowledge Integration Mechanism, Organizational Learning, and Human Capital

With regard to the relationship between knowledge integration mechanism and human capital, knowledge integration mechanism is defined as the integrating process of organizational learning to ensure knowledge sharing, utilization and practice between departments to enhance employee knowledge and experience storage (Kumar and Seth, 1998). Madhavan and Grover (1998) propose that knowledge integration mechanism plays the role of periodic information and knowledge feedback through the integrative process and structure. Obviously, knowledge integration mechanism has a positive impact on organizational learning.

Galunic and Rodan (1998) argue that firms confronting a considerable variation in external broad knowledge obstruct the absorptive capabilities of knowledge, experience, and technology; therefore, firms for the sake of reinforcing knowledge absorptive capability of employees develop knowledge integration mechanism to increase the stored accumulation of human capital (Galbraith, 1973). On the other hand, Hoppe and Postrel' (1999) indicate that firms run the risk of knowledge transfer and diffusion that will influence internal employee knowledge integration. At this time, firms must develop knowledge integration mechanism to reinforce organizational learning and accumulate human capital. To summarize the above ideas, we propose that knowledge integration not only strengthen knowledge absorption,

integration, and application on organizational learning, but also effectively promote quality and quantity of human capital. Based on the above discussion, we propose the following hypotheses:

H_4: knowledge integration mechanism has positive influence on organizational learning.

H_5: knowledge integration mechanism has positive influence on human capital.

RESEARCH DESIGN

This paper will apply structural equation modeling (SEM) to examine the empirical data from Taiwan's marketing firms. This approach allows the simultaneous investigation of measures and the hypothesized model. There were two statistical methods to analyze the hypothesized relationship. First, we would apply confirmatory factor analysis to extract factors of dimensions in terms of social capital, human capital, organizational learning, and knowledge integration mechanism. Second, we would use SEM model to testify the meditating roles of align relationships among social capital, human capital, organizational learning, and knowledge integration mechanism on the relation between social capital and human capital.

Research Conceptual Model

Based on previous hypotheses developed, this paper formulates the conceptual research model as Figure 1.

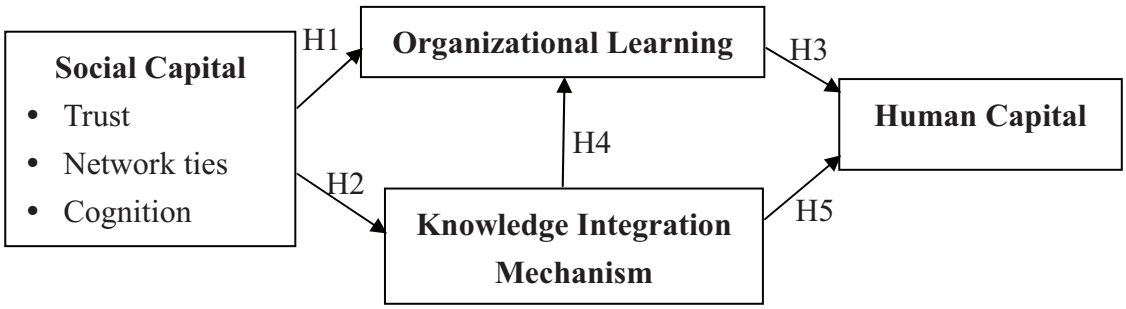

Figure 1: the conceptual research model

Sample and Data Collection

Based on previous literature, this paper explores the meditating roles of organizational learning, and knowledge integration mechanism on the relationship between social capital and human capital. The conceptual research model in this paper can serve as an initiation for further empirical study. This paper will use confirmatory factory analysis and structure

equation modeling (SEM) and hierarchical regression modeling statistics approaches to test the data collected from the first 3,000 manufacturing firms in Taiwan. In the other words, the mediator impact of organizational learning and knowledge integration mechanism on the causal relationship between social capital and human capital would be tested.

For the robustness of the study, we will test non-response bias in the data as well. In order to promote the response rate, we will contact target plant managers either by phone or letter to stimulate professional interest and improve our survey participation. Each of the variables was measured with a 7 point Likert scale (1 = strongly disagree, 7 = strongly agree).

Measurements

Based on the previous literatures, this paper identifies four dimensions in terms of social capital, human capital, organizational learning, and knowledge integration mechanism. Next, this paper will discuss measurements of these dimensions, respectively. Each of variables was measured with a 7 point Likert scale (1 = strongly disagree, 7 = strongly agree).

1. *Social Capital*

   Social capital indicates that based on network groups identified with the norms of networks, common vision, and reciprocity to apply embedded ties to share their information and resources to acquire new knowledge and complementary assets (Dyer and Hatch, 2006; Prabhu et al., 2005). This study adopts Nahapiet and Ghoshal (1998) and Inkpen and Tsang (2005)'s suggestions to develop trust, network ties, and cognition dimensions of social capital as the measured variables.

2. *Organizational Learning*

   Organizational learning is defined as firms acquire internal and external experience and knowledge thereby transferring to be the stored knowledge in databases or applying all kinds of organizational operational activities to improve the innovation capability (Huber, 1991). This study adopts Kumar and Seth (1998) and Luigi et al. (2007)'s suggestions to develop knowledge assimilation, knowledge integration, and knowledge application as the measured variables.

3. *Knowledge Integration Mechanism*

   Knowledge integration mechanism is defined as firms acquire, analysis, interpret, and integrate internal and external experience and knowledge through cross-functional structure and procedures (Zahra and Nielson, 2002). This study adopted Kogut and Zauder (1992), Crossan et al. (1999) and Gold et al. (2001)'s suggestions to develop the structure and process of knowledge integration mechanism as the measured variables.

4. *Human Capital*

   Human capital is defined as the knowledge, skills, and abilities owned and utilized by individuals. Human capital represents the knowledge, skills, experience and abilities

employees possess that bring unique and strategic value to firms (Barney, 1991; Ulrich and Lake, 1991). This study will adapt human capital aspects of Nahapiet and Ghoshal (1998) and Inkpen and Tsang (2005), and develop a seven-point scale to assess the overall skill and expertise of an organization's employees.

The questionnaire is reviewed and pre-tested by experts including managers and university faculty in the field of human resource management. Using convenience sampling method, the survey questionnaire will sent to manufacturing firms in the computer industries which are obtained from 2007 Taiwan 3,000 Manufacturers Directory. Respondents to the survey will be expected plant managers in their firm. In order to raise the response rate, we will contact plant managers of target plants by phone and by letter to stimulate professional interest and improve survey participation.

Control Variables

As a result of this study emphasis on the relationship between social capital and human capital that may be affected by of organization learning and knowledge integration mechanism as mediating variables. Firm size and the number of employees maybe affect the result of human capital (Florin et al., 2003). Therefore, this study will use firm size and the number of employees as the control variables. In addition, Pennings, Lee, and Witteloostuijn (1998) considered that human capital has high correlation with firm size and firm age. Therefore, this study not only uses firm size, but also firm age as control variables.

Statistical Methods

The conceptual research model explores the effects of social capital on human capital using organizational learning and knowledge integration mechanism as mediating variables is presenting in Figure 1. Statistical methods include: confirmatory factor analysis, structure equation modeling, and hierarchical regression analysis.

1. *Confirmatory Factor Analysis*
   Confirmatory factor analysis will be applied in this study which extracts factors of social capital, human capital, organizational learning, and knowledge integration mechanism with the principal component analysis. The principle components analysis will take the eigenvalue greater than one as the factor analysis criteria for our measured variables.
2. Structure Equation Modeling (*SEM)*
   A SEM methodology will be employed to test the hypotheses and the results of this analysis suggested to fix several indexes, such as chi-square test=6.13; the goodness-of-fit index [GFI]=.91; norm fit index [Nfi]=.96 (Bagozzi and Yi, 1988). The confirmatory

factor analysis (CFA) is to align the relationships among the social capital, human capital, organizational learning, and knowledge integration mechanism to test the convergent validity and discriminant validity.

3. *Hierarchical Regression Analysis*

   In order to further elaborate the mediation effects of the organization learning and knowledge integration mechanism on social capital and human capital, this study conducted hierarchical multiple regression to determine the best linear combination (Baron and Kenny, 1986), respectively entered variables in three stages as follows; 1 the causation between the independent variable and the mediating variable; 2.the causation between the independent variable and dependent variable; 3.mediating variables involved in regression models, based on the regression variable significant to determine the partial or full mediation effects of knowledge integration mechanism and organization learning.

Reliability and Validity Analysis

The reliability analysis uses Cronbach's coefficient alpha to judge the multi-dimensional construct of social capital, human capital, organizational learning and knowledge integration mechanism. All of the multi-item measures has to be $\alpha>0.70$, an indication of sufficient reliability (Churchill, 1979).

All measures were drawn from previous related research and aligned with the conceptual aspects of each construct. The questionnaire was pre-tested and modified by 2 academics in order to insure the survey content validity and measurement scales appropriateness. We will perform confirmatory factor analysis with Varimax rotation for data and then tested the measurement model for all items with a CFA for convergent and discriminant validity of the focal constructs.

Convergent validity concerns whether multiple measures of the same construct are in agreement. According to Anderson and Gerbing (1988), convergent validity can be tested with a measurement model pattern coefficient on its posited underlying construct is significant. The CFA use the following approach: the results of this analysis suggested to fix several indexes (chi-square test=6.13; the goodness-of-fit index [GFI]=.91; norm fit index [Nfi]=.96), and the CITC values are above 0.55 for the degree of the social capital, human capital, organizational learning, and knowledge integration mechanism exhibiting acceptable convergent validity.

Discriminant validity is an assessment of the extent by examining whether the indicators' estimated pattern coefficients loaded significantly on expected factors but not on other factors

of interest.

CONCLUSION

The most important strategic resources in an organization are the intangible assets of human capital and social capital which create and sustain a market advantage (Barney, 1991; McEvily and Marcus, 2005; McEvily and Zaheer, 1999). In this era of knowledge economics, at the standpoint of the dynamic environment, firms acquire knowledge through external social capital and transform employee knowledge effectively which is largely dependent on organizational learning (Lane and Lubatkin, 1998; Zahra and George, 2002). Knowledge integration makes the information and skills gained from internal and external expansion activities on integral component of the routines that guide the firm's future strategic actions (Teece et al., 1987). However, several previous studies of human resource management research has so far ignored the mediating role of organizational learning and knowledge integration mechanism in the research model regarding the relationship between social capital and human capital. Therefore, this study employs organizational learning and knowledge management mechanism as mediating variables to explore the impact of social capital on human capital. The relationships among social capital, organizational learning, knowledge integration mechanism, and human capital will be examined, and the mediator impact of organizational learning and knowledge integration mechanism on the causal relationship between social capital and human capital will be verified. Consequently, this conceptual framework would provide academics and practitioners for further investigation and basic of an empirical study in the near future.

APPENDIX

1. The following items had this stem and response format: "To what extent do you agree with the following items describing your organization's social capital? (1= strongly disagree; 7= strongly agree)."

Social Capital: Network Ties	Strongly Disagree←→ Strongly Agree						
1. Your company exists in embedded ties with suppliers from business activities.	1	2	3	4	5	6	7
2. Your company exists in embedded ties with suppliers from operational activities.	1	2	3	4	5	6	7
3. Your company links computer system directly with suppliers.	1	2	3	4	5	6	7
4. Your company has compatible computer system with suppliers.	1	2	3	4	5	6	7
5. Your company provides specific assets or equipment for suppliers.	1	2	3	4	5	6	7

6. Your company invests specific assets or equipment to your suppliers which is unable to shift to other companies.	1	2	3	4	5	6	7
7. Your company will consider the impact on suppliers when making important decision.	1	2	3	4	5	6	7
8. Your company is willing to cooperate with suppliers and would not disrupt this cooperation easily.	1	2	3	4	5	6	7

Social Capital: Trust Strongly Disagree←→Strongly Agree

1. Your company has high level of mutual trust with suppliers.	1	2	3	4	5	6	7
2. Your company can reliably communicate with your suppliers.	1	2	3	4	5	6	7
3. Your company has a high level of commitment to your suppliers.	1	2	3	4	5	6	7
4. Your company often communicates with suppliers face to face.	1	2	3	4	5	6	7
5. Your company share resource and technology with your suppliers.	1	2	3	4	5	6	7
6. Your company applies mutual complementary trough cooperation with suppliers.	1	2	3	4	5	6	7
7. Your company integrates different resource and capabilities with suppliers for synthesis.	1	2	3	4	5	6	7

Social Capital: Cognition Strongly Disagree←→Strongly Agree

1. Your company has a consistent goal of partnership with suppliers.	1	2	3	4	5	6	7
2. Your company shares a common goal in partnership with suppliers.	1	2	3	4	5	6	7
3. Your company can cooperate with organizational operation process with suppliers.	1	2	3	4	5	6	7
4. Your company is willing to make adjustment and change to fit the partnership.	1	2	3	4	5	6	7
5. Your company is willing to combine your efforts to obtain success with suppliers.	1	2	3	4	5	6	7

2. The following items had this stem and response format: “To what extent do you agree

with the following items describing your organizational learning? (1= strongly disagree; 7= strongly agree)."

Organizational Learning	Strongly Disagree←→Strongly Agree
1. The learning attitude of employee in the company has a positive impact on firm's performance.	1 2 3 4 5 6 7
2. Your employees eager to learn.	1 2 3 4 5 6 7
3. Your company changes its attitudes to enhance employee's learning aspiration for future development.	1 2 3 4 5 6 7
4. Employee continuing education is an investment, not an expense.	1 2 3 4 5 6 7
5. Employee's ability to learn is the key to improve achievement.	1 2 3 4 5 6 7
6. You company is concerned with the spirit of teamwork spirit than other companies.	1 2 3 4 5 6 7
7. Your company is concerned with cross-functional teamwork practices than other companies.	1 2 3 4 5 6 7
8. Your employees are better aware of your vision than other companies.	1 2 3 4 5 6 7
9. Your employees often share more knowledge and experiences than other companies.	1 2 3 4 5 6 7
10. Your employees utilize more knowledge and experience sharing than other companies.	1 2 3 4 5 6 7
11. Your company audit more failure and success endeavors than other companies.	1 2 3 4 5 6 7
12. Learning is regarded as the routines to evaluate persistent learning capability of employee.	1 2 3 4 5 6 7

3. Compare to other companies in your industry, please rate the extent you agree with knowledge integration mechanism at the following indicators (1= strongly disagree; 7= strongly agree).

Knowledge Integration Mechanism	Strongly Disagree←→Strongly Agree

1. Your company improves more tangible performance of sales revenue and intangible performance of culture and management than other companies through strategic alliances.	1	2	3	4	5	6	7
2. Your company systematically integrates more market survey or customer feedback than other companies.							
3. Your company integrates the results of market survey and customer feedback in strategic planning.	1	2	3	4	5	6	7
4. Your company reviews integrated data from departments to create the operational strategy.	1	2	3	4	5	6	7
5. Your company would integrate product line strategies of customer needs based on the external environment and internal adjustment.	1	2	3	4	5	6	7
6. Your company would integrate existing knowledge making the operational strategy, such as existing database and draw support from alliance member capability to reach win-win situation.	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

4. Compare to other companies in your industry, please rate the extent you agree with your company's human capital at the following indicators (1= strongly disagree; 7= strongly agree).

Human Capital Strongly Disagree←→Strongly agree							
1. Employees are the greatest assets of our company.	1	2	3	4	5	6	7
2. Your company provides much incentive for employee continuing education. e.g., incentive pay	1	2	3	4	5	6	7
3. Your company provides employee periodic training program.	1	2	3	4	5	6	7
4. Employees always discover new products and new market opportunities.	1	2	3	4	5	6	7
5. Your employees work together to confront crises.	1	2	3	4	5	6	7
6. Your employees are recognized great achievers for enhancing the organizational performance.	1	2	3	4	5	6	7
7. You think your employees are bright and highly skilled.							
8. Your employees possess expertise.	1	2	3	4	5	6	7
9. Your employees follow your company's belief and goal.	1	2	3	4	5	6	7
	1	2	3	4	5	6	7

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Using Ontology to Improve the Reusability of Inter-organizational Knowledge: An Collaborative Knowledge Management Network

Nelson K. Y. Leung, RMIT International University Vietnam, Vietnam
nelson.leung@rmit.edu.vn

Sim Kim Lau, University of Wollongong, Australia
simlau@uow.edu.au

Joshua Fan, University of Wollongong, Australia
joshua@uow.edu.au

Seung Hwan Kang, Payap University, Thailand
seung_h@payap.ac.th

ABSTRACT

Ontology allows web content to be represented in a structural form by a finite list of vocabularies and their relationships. Thus, the concept of ontology and its related mediation methods is capable of enhancing the collaboration among Knowledge Management (KM) approaches that only focus on managing organizational knowledge. Those KM approaches are developed in accordance with organizational KM strategies and business requirements without the concern of system interoperation. In this research, a collaborative inter-organizational KM network is proposed to provide a platform for organizations to access and retrieve inter-organizational knowledge in a similar domain. Ontology and its mediation methods are applied to the proposed KM network to enable heterogeneous Knowledge Management Systems (KMSs) from different organizations to communicate, cooperate, exchange as well as reuse knowledge with one another. A selection framework is also proposed to assist organizations in choosing suitable ontology mediation approaches. The retrieved inter-organizational knowledge could be used to support organizational KM process. While knowledge engineers could reuse inter-organizational knowledge to create and evaluate organizational knowledge, general users are benefit from the effectiveness and efficiency in searching for relevant inter-organizational knowledge within the network.

Keywords: Ontology, Mediation, Mapping, Merging, Integration, Knowledge Management

INTRODUCTION

Over the past two decades, a lot of efforts have been placed in order to integrate heterogeneous information systems. This integration is essential because systems of different characteristics would be able to communicate, cooperate, exchange information as well as reuse knowledge and services with one another. Especially in the era of the Internet, a transaction can hardly be completed without making use of others' data, information, knowledge and services. For instance, when customer is shopping in an online store, s/he may need to seek comments on the quality of a particular product from an external forum. Once s/he decides to purchase the product, the online store will have to contact related financial institutes for payment verification and confirmation. The online store is also required to arrange delivery service with

shipping company. Such a simple online shopping transaction would involve interoperation of at least three heterogeneous information systems, the complexness could be imagined if it is a multi-million trade that involves the participation of more enterprises.

Artificial intelligence researchers first applied the concept of ontology in intelligence system development so that knowledge could be shared and reused among artificial intelligence systems. Ontology as a branch of philosophy is the science of what is, of the kinds and structures of objects, properties, events, processes and relations in every area of reality (Smith 2003). Ontology can be further elaborated as a particular system of categories accounting for a certain vision of the world (Guarino 1998). The term, ontology, was then borrowed by artificial intelligence community and Tom Gruber's definition was widely accepted within the community: an ontology is an explicit specification of a conceptualization while a conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose (Gruber 1993). Later on, Borst (1997) refines Gruber's definition by labelling an ontology as a formal specification of a shared conceptualization. Based on Gruber's and Borst's definitions, Studer, Benjamins and Fensel (1998) make the following conclusion: 1) an ontology is a machine-readable specification of a conceptualization in which the type of concepts used and the constraints on their use are explicitly defined, and 2) an ontology should only capture consensual knowledge accepted by large group of people rather than some individual. By representing knowledge with representational vocabulary in terms of objects and their interrelated describable relationships, inference engine and other application program from one intelligence system will be able to understand the semantic of knowledge in another knowledge base.

The popularity of the semantic web further magnifies the importance of ontology. The Semantic Web is the extension of the current one, in which web content is represented in a structural form within ontologies by a finite list of vocabularies and their relationships (Berners-Lee 2001). In this way, ontologies enable computer program, software agent and search engine to understand the semantics, thus making it possible for them to process the web content. Ontologies also provide a shared understanding of a domain which is necessary to overcome differences in terminology from various sources (Antoniou and Harmelen 2004).

Unfortunately, it is unrealistic to expect all individuals and organizations will agree on using one or even a small set of ontologies (Bruijn et al. 2006). The adoption of such an approach is problematic. On one hand, it is lengthy and non-trivial to define and maintain a large globally shared ontology, on the other hand, the globally shared ontology approach may hinder a system from reflecting its actual business requirements due to the fact that design of the system is restricted by terminologies defined in the ontology (Leung, Lau and Fan 2007). Researchers such as Berners-Lee, Hendler and Lassila (2001) state that there would be a large number of small domain specific ontologies developed by communities, organizations, departments or even individuals. While multiple ontologies allow system to be designed according to its actual requirements without committing to a particular set of terminologies, data heterogeneity caused by multiple ontologies has become an obstacle for the interoperation of systems. Since vocabularies and their relationships defined in the ontologies are inconsistent, therefore it is impossible for one system to understand and reuse other ontologies unless the ontologies are reconciled in some form. The above inconsistent problem caused by multiple ontologies is commonly termed as ontology mismatches.
This research describes the three main meditation methods used to reconcile mismatches between heterogeneous ontologies. The research also investigates the application of ontologies

and its mediation methods in the aspect of Knowledge Management (KM). The rest of the Chapter is organized as follows. Section 2 describes various approaches of ontology mediation. Section 3 discusses the application of ontology and its mediation methods in KM. This includes the development of a proposed mediation selection framework and ontology-based collaborative KM network. Finally, conclusion is given in Section 4.

APPROACHESPPROACHES OF ONTOLOGY MEDIATION

Based on the actual requirements, organizations and individuals are expected to develop their own ontologies of different languages, scopes, coverage and granularities, modelling styles, terminologies, concepts and encodings. To reuse other ontologies of different types, ontology mediation is required to reconcile mismatches between heterogeneous ontologies so that knowledge sharing and reuse among multiple data sources can be achieved (Predoiu et al. 2006). There are three major kinds of ontology mediations which include mapping, merging and integration. Ontology mapping is a process of relating similar concepts and relations from different ontologies to each other in which the correspondences between different entities of the two ontologies are formulated as axioms in specific mapping language (de Bruijn et al. 2006). Since the involved ontologies do not require any adaptation, ontology mapping often specifies just a part of the overlap between ontologies which is relevant for the mapping application (Scharffe, de Bruijn and Foxvog 2006). Two common approaches used to establish mapping between ontologies are listed as follows.

- The first approach is to relate all ontologies to a common top-level ontology so that different ontologies are mapped together indirectly by the top-level ontology (de Bruijn et al. 2006). Consequently, conflicts and ambiguities can be resolved since concepts used in different ontologies are inherited from the common ontology. However, this approach has three major drawbacks. First, constructing a large-scale common top-level ontology from scratch is never a simple task. Even if we take a simpler path by merging various local ontologies together, the experiences of building the Suggested Upper Merged Ontology (SUMO) tell us that the actual merging processes are trickier than expected, not only because there is inconsistency between chunks of theoretical content but also because there were structural differences between the local ontologies (Niles and Pease 2001). Second, this approach can only be adopted in a relatively stable environment where maintenance is minimal because a substantial amount of resources and overheads are required to maintain a common top-level ontology. Third, established mappings between local ontologies and top-level ontology can easily be affected by the elimination and addition of local ontologies as well as changes in either local or common ontologies because local ontologies are related indirectly with each other through the common ontology.
- Rather than mapping all ontologies to a common top-level ontology, one-to-one mapping approach requires mappings to be created between each pair of ontologies (Predoiu et al. 2006). The lack of a common top-level ontology in this approach makes it possible to be adopted in a highly dynamic environment. This advantage may be offset by the lack of common terminologies, thus increasing the complexity of defining mapping between local ontologies. Another major drawback of this approach occurs when a large number of heterogeneous ontologies are involved in the interoperation. Such an interoperation will greatly increase the amount of mappings and extra effort is required to control and maintain the mappings.

The second type of ontology mediation is merging. Unlike mapping that links two separate ontologies together in a consistent and coherent form, ontology merging creates a new ontology (in one subject) by unifying two or more different ontologies on that subject and it is

usually hard to identify regions of the source ontologies from the merged ontologies (Pinto and Martins 2001). As compared with mapping that keeps the original ontologies unchanged, merging requires at least one of the original ontologies to be adapted so that the conceptualization and the vocabulary match in overlapping parts of the ontologies (Ding et al. 2002). While a majority of semantic web researchers foresee the main stream would switch to the approach of developing enormous amount of small domain specific ontologies, McGuinness et al. (2000) argue that some of the industries or organizations still require to develop very large and standardized ontology, for instance, SNOMED CT is a comprehensive clinical ontology developed by the College of American Pathologists that contains about 344,549 distinct concepts and 913,697 descriptions (Lussier and Li 2004). Theoretically, it is more efficient and effective to merge existing ontologies than to build a large ontology from scratch. In practice, the process of ontology merging is more than just simple revisions, improvements or variations of the source ontologies since the involved ontologies are developed by different people for different purposes with different assumptions and using different vocabularies (Pinto and Martins 2001).

One of the most important phrases in the process of ontology mapping and merging is ontology matching. In general, ontology matching can be defined as the process of discovering similarities between two ontologies with the purpose of establishing semantic relationships in between (Studer, Benjamins and Fensel 1998). It determines the relationships holding between two sets of entities that belong to two discrete ontologies. In other words, it is the process of finding a corresponding entity in the second ontology for each entity (for example, concept, relation, attribute and so on) in the first ontology that has the same or the closest intended meaning. This can be achieved by analysing the similarity of the entities in the compared ontologies in accordance with a particular metric (Ehrig and Sure 2004). Ontology matching (or similarity computation) can be processed exploiting a number of different techniques. To provide a common conceptual basis, researchers have started to identify different types of ontology matching techniques and propose classifications to distinguish them, for example, Shvaiko and Euzenat (2005) propose a classification that consists of ten ontology matching techniques. Another example is the classification framework developed by Leung, Lau and Fan (2001). Their framework provides an effective method to identify seven types of matching techniques and its related executive approach simply by examining the input of mediation system. The seven types of techniques are string-based, linguistic resources, constraint-based, alignment reuse, graph-based, taxonomy-based and model-based.
Finally, the third type of ontology mediation is integration. Pinto & Martins (2001) define ontology integration as a process of building an ontology in one subject reusing one or more ontologies in different subjects and it is always possible to identify regions of the source ontologies from the integrated ontologies. Source ontologies may need some sort of refinements before they can be aggregated, combined and assembled together to form the resulting ontology. It is also important to include ontology integration in the early stage of the ontology building process, preferable during conceptualization and formalization, so as to simplify the overall ontology building procedure.

APPLICATION OF ONTOLOGY IN KNOWLEDGE MANAGEMENT

The concept of ontology and its related mediation methods can also be applied to solve the interoperation problem in the distributed KM environment. At the very beginning, KM is emerged with the purpose of preserving and capitalizing on organizational knowledge for the future benefit of organizations. KM encourages organizations to create and use knowledge continuously for the innovation and enhancement of service, product and operation.

Simultaneously, it also aims to improve the quality, content, value and transferability of individual and group knowledge within an organization (Mentzas et al. 2001). This is achieved by organizing formal, direct and systematic process to create, store, disseminate, use and evaluate organizational knowledge using the appropriate means and technologies.

Nonaka, Toyama & Konno (2001) suggest that there are four methods to create organizational knowledge by means of interaction between explicit and tacit knowledge. While tacit knowledge is personal, complex and hard to communicate and formalize because it is gained through individual insights overtime and is resided in human, mind and body, explicit knowledge is structured, relatively simple and can be captured, recorded, documented, codified and shared using formal and systematic language (Goh 2002). The first method to create knowledge is socialization. It is the process of developing new tacit knowledge from tacit knowledge embedded in human or organization through experience sharing, observation and traditional apprenticeship. The second method is called externalization. This is the process of turning tacit knowledge into new explicit knowledge simply by transforming tacit knowledge in the form of document such as manual and report. The third method is combination. This is the process of merging and editing "explicit knowledge from multiple sources" into a new set of more comprehensive and systematic explicit knowledge. The last one is called internalization. This is the process of embodying explicit knowledge as tacit knowledge by learning, absorbing and integrating explicit knowledge into individual's tacit knowledge base.

The second and third stages of KM, store and disseminate are often linked with technologies. Explicit knowledge created is collected and stored in some sort of database or knowledge base in which the users can access using "search and retrieve" tools, intranets, web access and applications, groupware and so on (Alavi and Leidner 1999). The retrieved knowledge can then be used by knowledge workers to add value to current business process, implement and coordinate organizational strategy, predict trends in the uncertain future, deliver new market values, create new knowledge, solve existing problems and so on (Bailey and Clarke 2001). The fifth stage of KM is knowledge evaluation. This phrase eliminates incorrect or outdated knowledge (Alavi and Leidner 1999). In other words, organization must keep creating new knowledge to replace any knowledge that has become invalid.

Unfortunately, it is shown that some of the KM approaches, ranging from industrial specific, theoretical, to procedure-wise, are incompetent to cooperate with the current distributed knowledge environment, especially those that are designed to manage merely organizational knowledge, for example, the re-distributed KM framework is developed to manage organizational help desk knowledge (Leung and Lau 2006). Those approaches are tailor-made according to different organizational KM strategies and business requirements without the concern of system interoperation. The lack of interoperability means that heterogeneous Knowledge Management Systems (KMSs) from different organizations are not able to communicate, cooperate, exchange as well as reuse knowledge with one another. Wagner and Buko (2005) argues that knowledge-sharing in an inter-organizational network allows a richer and more diverse body of knowledge to be created as compared with sharing in one organization.

The non-collaborative KMSs have several disadvantages for both knowledge workers and knowledge engineers. In terms of knowledge workers, they have to spend a lot of time and effort to look for relevant knowledge from different KMSs because they are often required to

access knowledge from other knowledge sources in order to complete their works in the knowledge explosion era, for instance, an investment manager has to retrieve company's financial report, share performance report and regional economy reports from external sources if s/he wants to adjust the proportion of a particular share in the investment portfolio. In terms of knowledge engineers, they have to waste a lot of resources in creating and updating organizational knowledge even though the same knowledge is available in other KMSs. As external source of knowledge is essential for organizational performance, a new inter-organizational KM practice is required to enhance the interoperability among independent KMSs and to encourage the sharing of knowledge across organizational boundaries in their business networks (Oinas-Kukkonen 2005).

Nevertheless, the absence of a common language or standardization has put up a barrier to prevent the collaboration of KMSs (Sheth 1999). Although the emergence of middleware technology has provided a way to enhance the interoperability of KMSs, the concept of middleware can hardly be accommodated in the era of the Internet as each pair of KMSs are required to implement a tailor-made middleware for interoperation (Leung, Lau and Fan 2007). Since a single KMS is interconnected with a huge amount of systems via the Internet, it is impractical to customize and install a middleware for each connection. Another deficiency of middleware is that even if the involved systems only undergo minor modification, the middleware may require a complete re-construction.

Ontology-based Collaboration Inter-organizational Knowledge Management Network

Let us consider the following scenario. At the University A, if an academic researcher is in need of information systems (IS) related literatures (for instance, literatures related to "inter-organizational KM"), the first thing s/he can do is to access the website of the university library. S/he can then type in a set of keywords in the search interface of the library website to determine whether the relevant literatures are available in the library. If it does, then s/he can choose to pick up the literatures from the library or download them in soft-copy format. If not, s/he will have to search again in various literature knowledge bases subscribed by the library. Literature knowledge bases allow subscribers to retrieve literatures such as journals, conference papers, books or other forms of manuscripts. Unfortunately, this process needs to be repeated for every single knowledge base until s/he can find the desired literatures. Each knowledge base contains different sets and types of literatures based on publishers or disciplines areas such as IEEE Xplore (IEEE) and ACM Digital Library (ACM) mainly contain computer related journals and conference papers that are published by IEEE and ACM respectively whereas Australian Digital Theses Program stores thesis of any disciplines produced by postgraduate research students at Australian universities. Finally, if s/he still cannot find any related literature, s/he may choose to search again using other search mechanisms such as Yahoo and Google.

In this research, we propose to use ontology and its related mediation methods to solve the collaboration problem of heterogeneous KMSs in the Internet environment. Ontology is incorporated to allow explicit knowledge to be annotated in the form of machine processable metadata. Although different organizations possess their own set of ontologies, the mediation methods are capable of reconciling the underlying heterogeneities of ontologies. In this way, the concept of ontology and mediation enables organizational KMS to understand incoming request and the returned knowledge, thus making it possible for them to collaborate and communicate with each other. We argue that the knowledge reusability and mismatches reconcilability of ontology and its related mediation methods can further contribute towards reformation of existing KM frameworks that focus only on managing organizational knowledge. Therefore, we propose to develop an ontology-based collaborative inter-organizational KM network that provides a platform for organizations to access and reuse inter-organizational knowledge with a similar domain. Here, inter-organizational knowledge is defined as a set of explicit knowledge formalized and created by other organizations. In the network, the

formalized inter-organizational knowledge is reusable in a way that it can be retrieved by any organizations to support their own KM processes in terms of knowledge creating, storing, dissemination, using and evaluation.

Each network should only contain knowledge of a specific domain to ensure knowledge workers can retrieve relevant knowledge in an efficient manner, for example, an IS network should only provide knowledge in the discipline area of IS. Once an organization recognizes the need for a certain type of knowledge, the organization can invite other organizations and knowledge providers with the same knowledge domain to establish a network together. For example, given that academic researchers in IS discipline have to access different knowledge bases in order to obtain the desired knowledge, the library at this university decides to invite other libraries and academic publishers to establish a knowledge network that contains only IS knowledge. When the network for a particular knowledge matures, organization in need may choose to join instead of establishing new one. Within a network, each organization or knowledge provider must commit to a mutual agreement to allow other participants to access an agreeable portion of ontology and the associated knowledge in its knowledge base. Besides, a single organization or knowledge provider can commit to more than one network of different domains. For instance, the library of the University A may choose to commit to networks of IS, economics, mechanical engineering, education and chemistry whereas IT help desk of Company A may choose to commit to network of other hardware and software providers' knowledge bases.

Selection Framework for Ontology Mediation

Before continuing the description of the proposed network, the participating organization must first make four important decisions related to ontology mediation. Figure 1 illustrates a selection framework for ontology mediation in the form of a matrix. The first decision is whether to adopt top-level ontology or one-to-one as the network level mapping approach. As this decision is on the network level rather than an organizational aspect, the organizations as a whole must compromise in order to select the most appropriate mapping approach for the benefit of the entire network. The decision process should include a thorough assessment and discussion from the aspects of resources, expertise and frequency of modification among all organizations in the network. The top-level ontology approach can only be applied to an environment where maintenance effort is minimal even though such an approach can provide a better mechanism to resolve conflicts and ambiguities. Whenever a minor modification is performed in one of the ontologies in the network, the shared ontology used in the top-level ontology approach may need a complete reconstruction. The organizations must also make sure that they have sufficient resources and expertise to build the shared ontology. If frequent maintenance is required or resources and expertise are insufficient, it may be more appropriate to use the one-to-one approach.

The second decision is whether to perform mediation automatically or semi-automatically. Mediation can be performed semi-automatically which requires the support of automatic tools as well as human intervention. The forms of support provided by automatic tools include similarity computation, post-mediation verification, validation, critiquation as well as conflict recognition and resolution. Although semi-automatic mediation could have a better performance than the manual one in terms of accuracy, it still substantially relies on human efforts and can be time consuming. Without human intervention, the process of semi-automatic mediation cannot be completed, thus compromising accuracy of the mediation result. As semi-automatic tool is not capable of supporting mediation on-the-fly, it would be ideal to perform mediation automatically. Unfortunately automatic tools are unable to detect and interpret concepts that do not have close correlation. Moreover, it may also fail to handle any unforeseeable situations as the tool is designed to perform mediation under certain pre-

defined conditions. However, if automatic mediation is adopted and inference mechanism is built on top of it, then inaccurate results can reduce the value of the mediation process.

The third decision is whether to adopt merging, mapping and/or integration as the desired mediation method for each organization. Each organization can choose one or more methods based on its own need. The concept of mapping enables ontology to be developed in response to its actual business requirement and is more suitable in a fluctuant business environment. Here, fluctuant business environment refers to an environment where organizations need to modify their ontologies in a frequent manner. Unless ontology has undergone major modification, simple modification, such as adding or deleting a concept from ontology, may merely require updating the mappings accordingly. Alternatively, merging is an appropriate method for creating an ontology that combines common views of multiple source ontologies. In other words, the merged ontology should include all possible correspondences and differences among the entire set of source ontologies. As a result, the merged ontology could act as 1) a single ontology used to substitute individual source ontology, 2) a shared ontology (reference point) used in top-level ontology mapping approach, or 3) an organizational ontology that includes all possible views of other organizations' ontologies. Unlike merging, integration selects only opposite modules from individual source ontologies to form an integrated ontology. Thus, integration is appropriate for organizations to customize ontologies based on their own needs. For example, the library at University A can customize a KM-based ontology by integrating portions of ontologies derived from other libraries and other academic publishers.-The final thing needs to be considered is whether to adopt single or multiple matching techniques. In the decision process, organization must also take into consideration execution duration, acceptable level of matching accuracy and resources level for implementation. In general multiple strategies are expected to generate more accurate result than single matching technique; however it is not always the case. The choice of aggregation algorithm and cut off point also plays an important role in determining the level of matching accuracy. When choosing multiple strategies as its matching technique, organization must conduct a series of experiments with the purpose of finding the right combination of multiple strategies, aggregation algorithm and cut off point to produce the most accurate result. Compare with single matching technique, multiple strategies are relatively difficult to design and implement and it requires longer execution time.

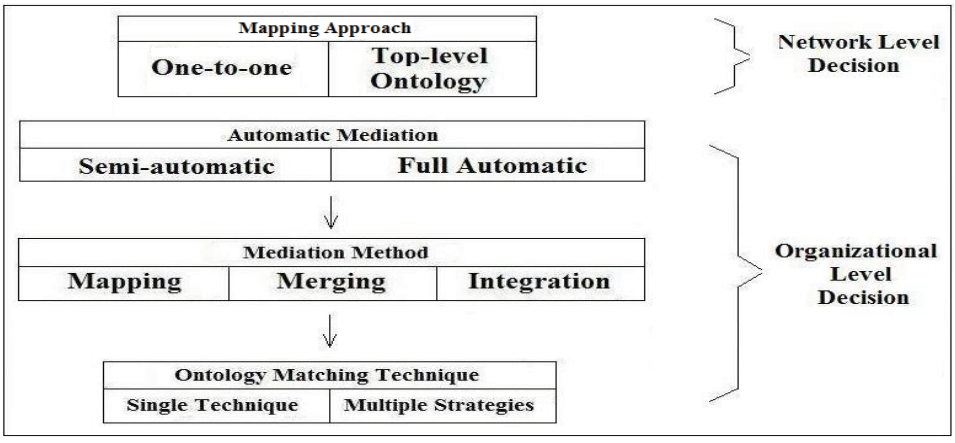

Figure 1: Selection Matrix for Ontology Mediation

The reconcilability of ontology mediation allows the participating organizations to reuse inter-organizational knowledge within the network even if there are fundamental differences among organizations in terms of KMS structures and formats. Under mutual agreement, organizations are permitted to retrieve inter-organization knowledge and the retrieved knowledge can be reused to support the five stages of KM process. Conventionally, technology has very limited contribution in knowledge creating stage especially in socialization, externalization and internalization where tacit knowledge is involved. For example, word processing tools can be used to record and visualise explicit knowledge in externalization and internalization, whereas communication tools such as email and telephone provide platforms for exchanging explicit knowledge in socialization.

However, ontology merging tool can provide a practical way to create knowledge by combining two or more ontologies together semi- or automatically in the network. This can be achieved on both network and organizational level. On the former level, merging tool is capable of creating a shared ontology for top-level mapping approach that contains common views of all organizational ontologies in the network. On the latter level, organization can create its own domain specific ontology by merging relevant ontologies from other organizations within the network. In addition, ontology integration tool provides an alternative way to create knowledge. Using integration method, organization can create its own knowledge by integrating relevant parts of ontologies from other organizations in the network into its own ontology building process. As a result, both merging and integration tool enable organizations to reuse not only the contents of other ontologies but also their associated inter-organizational knowledge stored in the knowledge bases of other organizations. While ontology merging and integration are never a trivial task even with the assistance of automatic tools, they are still less demanding than building it from scratch.

Knowledge dissemination tool allows user to retrieve and use knowledge from organizational knowledge repository. If user cannot find suitable organization knowledge, s/he has to seek from other external sources. This can be achieved by creating mappings among ontologies of different organizations either semi- or automatically with the support of ontology mapping tool. The established mappings allow one KMS to access another KMS in the same network. Besides, it is also practical for mapping to be performed on-the-fly. In this case, automatic mapping tool is responsible to look for, select and establish mapping with the most relevant concepts and properties from other ontology in the network. Whenever the required knowledge is not available in the organizational repository, the KMS is able to retrieve and deliver inter-organizational knowledge in a “black box” through the establishment of mappings. In addition, inter-organizational knowledge can be reused to support knowledge evaluation process. This is accomplished by setting up dedicated mapping between two or more ontologies. Once a piece of inter-organizational knowledge is updated, this it will be translated into a suitable format and delivered from source knowledge base to the target automatically via the pre-established mappings. To demonstrate the reconcilability of ontology mediation and reusability of inter-organizational knowledge in the network, let us consider the following scenario.

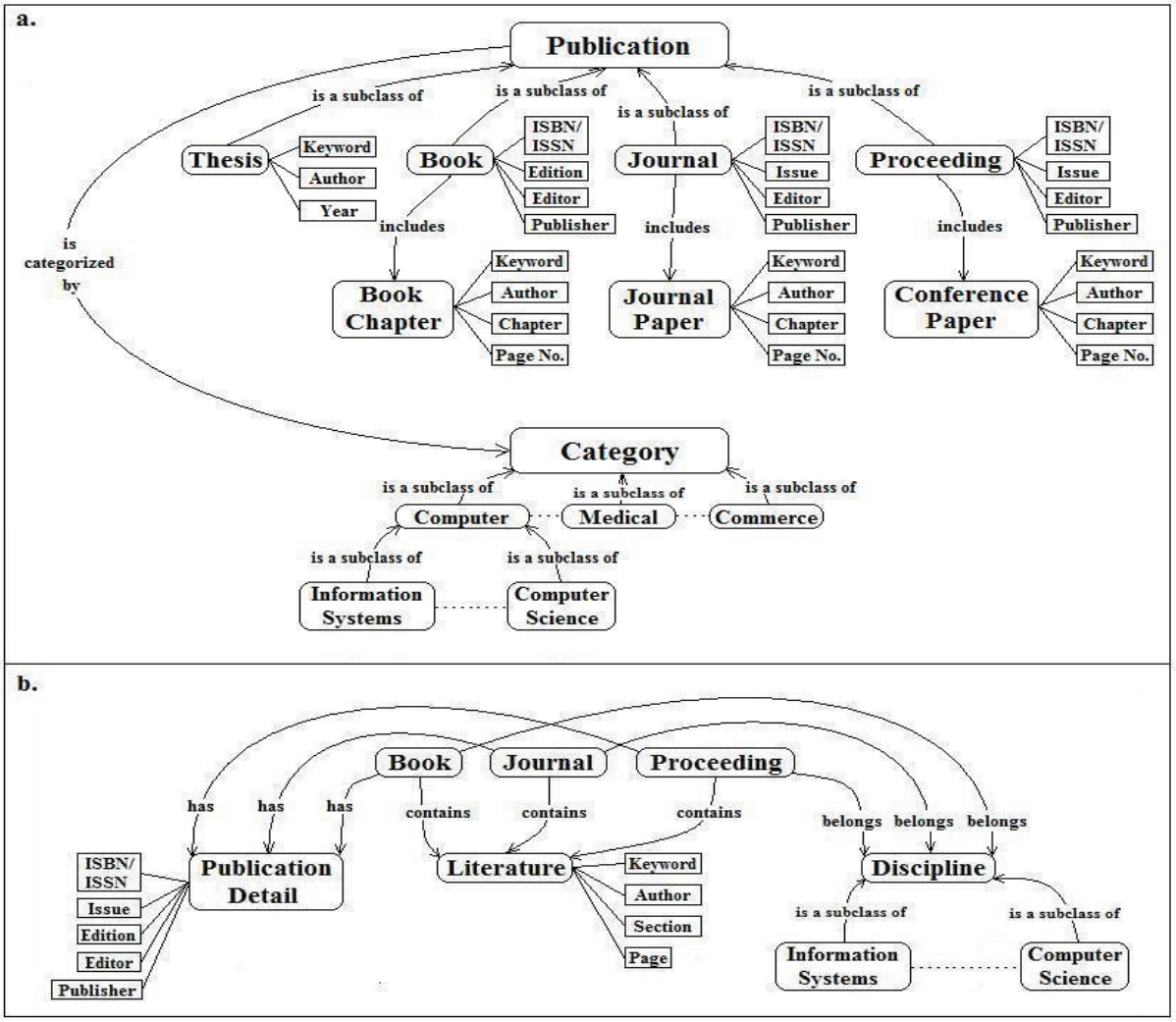

Figure 2: Partial View of the Classification Ontology Adopted in (a) Library of University A and (b) Publisher XYZ. Round Rectangular Nodes Represent Concepts. Rectangular Nodes and Labels on the Arcs Represent Properties

Assuming University A realizes that there is an increasing demand for IS related knowledge, and this demand cannot be satisfied with current collection of publications in the library. Consequently, University A decides to invite knowledge providers and libraries of other universities to establish a network that contains IS related literatures which include libraries of University B, University C, University D, Publisher ABC and Publisher XYZ. Except for University D, all other participating organizations possess ontologies. Figure 2a shows a partial view of the classification ontology adopted in the library of University A. In this ontology, the publication concept has concepts that include book, journal, proceeding and thesis as its subclasses and each subclass is described by a set of properties such as International Standard Book Number (ISBN), International Standard Serial Number (ISSN), and publisher. Concept category and its subclasses are used to distinguish publications into different subjects such as concept computer, medical, commerce, computer science and so on. Given that this network only supports IS related knowledge, therefore the library of University A is willing to share publication that belongs to concept computer and its subclass information systems. As publication may contain chapters written by different authors, the ontology reflects it by including concept book chapter, journal paper as well as conference paper and their related properties as an extension of concept book, journal and proceeding respectively.

Figure 2b shows a partial view of the classification ontology in Publisher XYZ. There are three major concepts in this ontology, that is, concept book, journal and proceeding. Each concept has a set of publication details (such as issue and edition), contains a set of literatures and belongs to one discipline (such as information systems). The above three components are represented by concept publication detail, literature and discipline respectively. Similar to University A, Publisher XYZ also agrees to share literatures that are classified under concept information systems.

After careful consideration, the six organizations have reached a mutual agreement not to adopt top-level ontology as the network-wide mapping approach. This decision is based on the fact that there will be many more organizations wishing to join the newly established network, so the shared ontology built for the top-level ontology mapping approach may require to undergo a series of reconstructions. Although they have sufficient expertise and resources to build and reconstruct the shared ontology, it is not cost effective to do so. In addition, the reconstruction works will definitely affect the stability and performance of network-wide mediation because the shared ontology will be mapped by all other ontologies as a reference point. At this moment, the organizations prefer to use one-to-one mapping approach. However they have agreed to review the mapping approach after the organizations wishing to join the network stabilized.

As the library of University D does not possess ontology, the library has to create one in order to fulfil the requirement of joining the network. Instead of building the ontology from scratch, the library decides to reuse ontologies from other organizations and integrate them into its own development process using ontology integration method. However, the chosen ontologies must be similar to the library's actual classification in terms of publication and discipline in order to minimize the degree of modification. For example, the concept publication and its subclasses in the ontology of University A are more appropriate than those defined in Publisher XYZ as the subclass thesis; book, journal and proceeding defined in the ontology of University A are very similar to the actual classification used in the library of University D. Based on the criteria, the library reuses only a portion of the two ontologies that include the concept publication and its subclasses derived from the ontology of the University A as well as the concept discipline and its subclasses derived from the ontology of Publisher XYZ (see Figure 3). In the ontology development process, the library of University D can reuse not only the ontologies of other organizations; it also has the inter-organizational knowledge associated with the instance of the integrated ontology. As illustrated in Figure 3, the softcopy of the thesis described by the instance of the integrated ontology, thesis "Turning User into First Level Support in Help Desk: Development of a Web-based User Self-help KM System" in discipline IS, can be captured from the knowledge base of the University A and stored in the knowledge base of University D. This integrated ontology created by the library of the University D has resulted in additional function. By establishing dedicated mappings between the integrated ontology and its ontology providers (that is, the ontologies of University A and Publisher XYZ), the associated publication captured in the knowledge base of University D can be automatically updated as long as there is an revised version generated from the ontology providers. In this case, when the thesis "Turning User into First Level Support in Help Desk: Development of a Web-based User Self-help KM System" has undergone a minor revision in the knowledge evaluation process, the revised thesis will not only be stored in the knowledge base of University A, it will also be broadcasted to other KMS through the dedicated mappings that includes the knowledge base of University D. To allow general user to retrieve and use inter-organizational knowledge, organizations are required to establish

mappings between its own ontology and ontologies of other organizations in this network. As shown in Figure 4, each broken line represents a mapping between a pair of concepts or properties that belong to two different ontologies. Making use of string-based and linguistic resources matching techniques, two similar concepts from the ontologies of University A and Publisher XYZ are mapped with each other. For instance, two identical concepts (such as journal) and two properties that are synonyms (such as section and chapter) from the ontologies of University A and Publisher XYZ are mapped together.

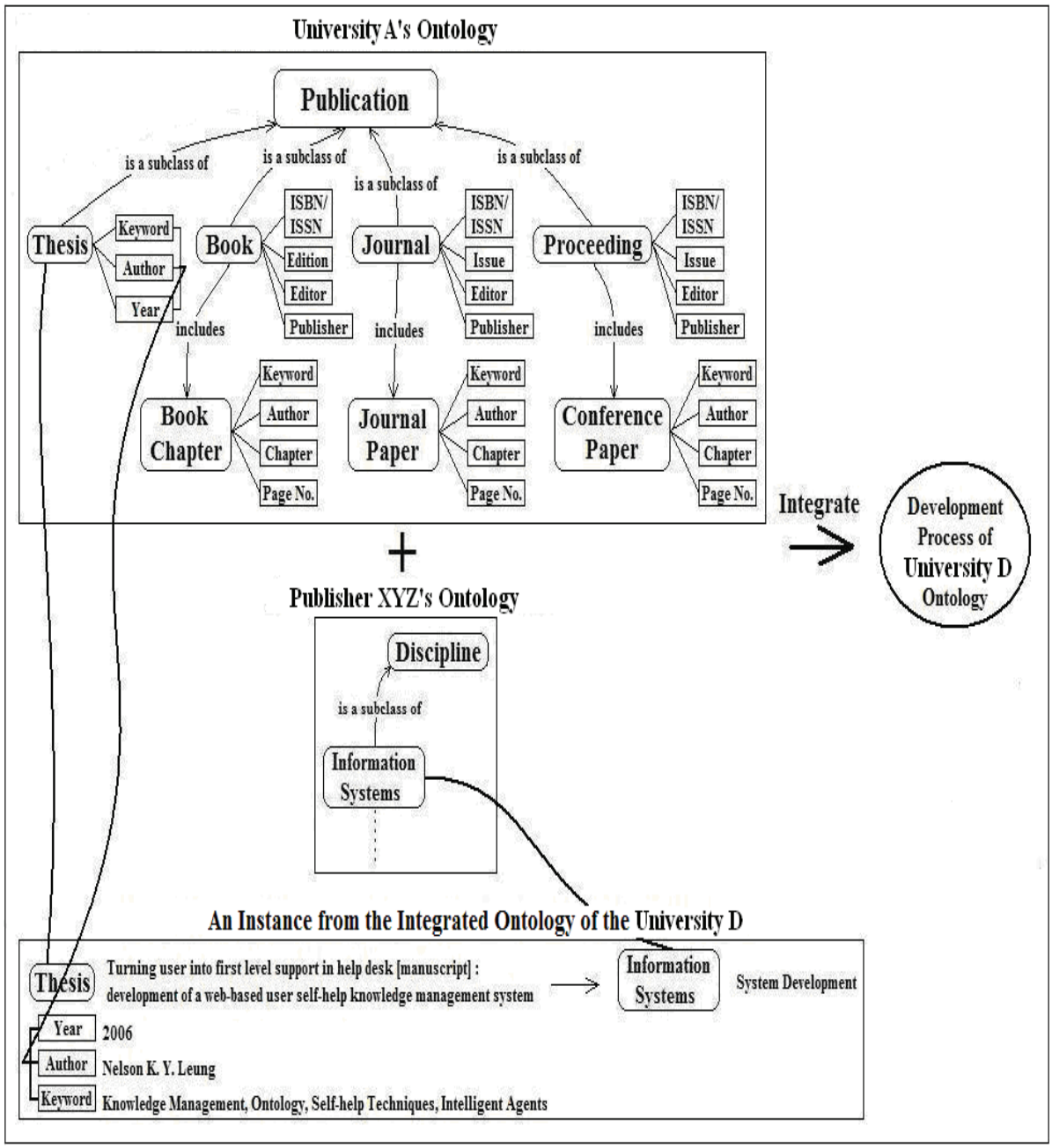

Figure 3: Process to Develop University D's Ontology Using Integration Method

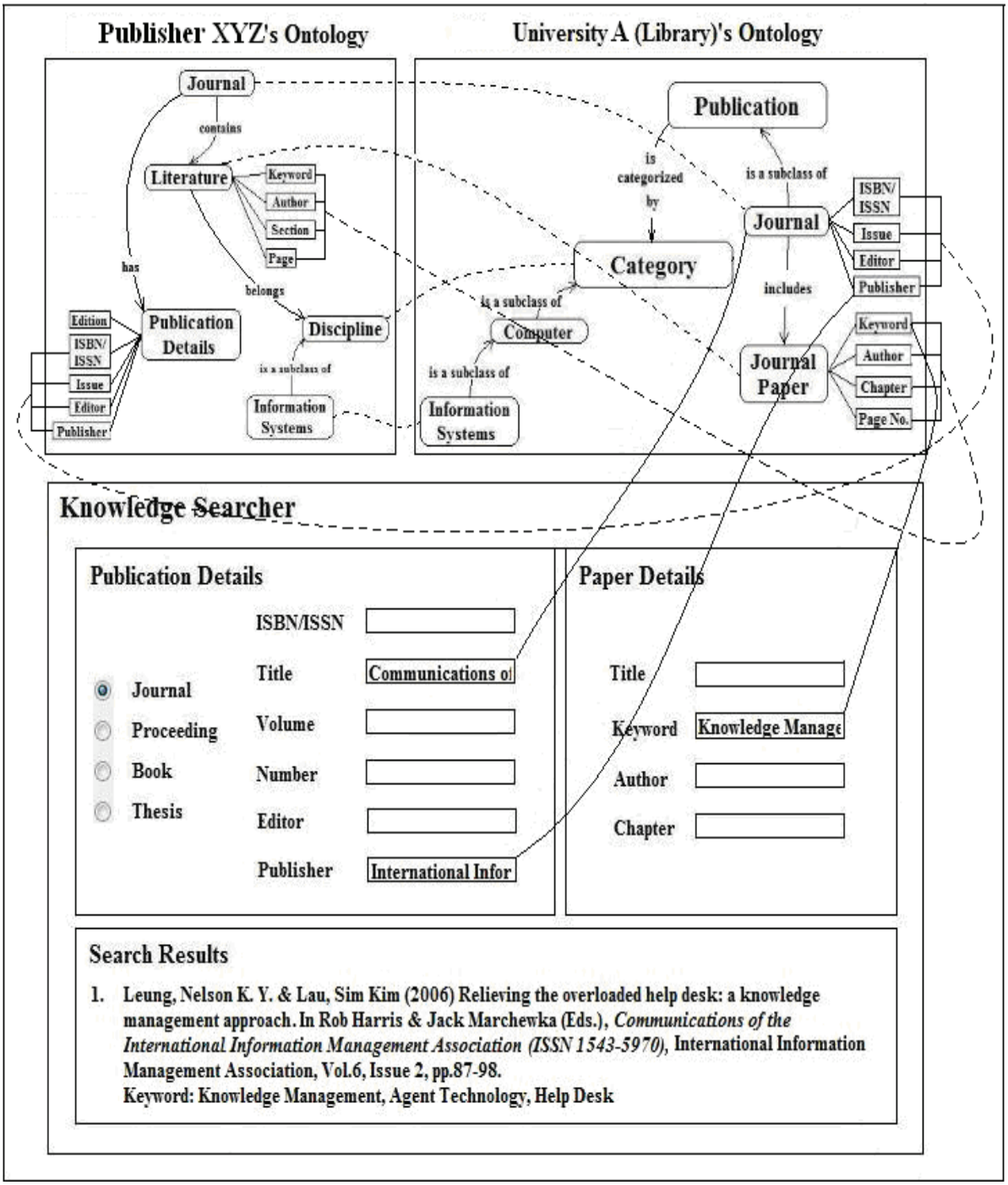

Figure 4: Inter-organizational Knowledge Retrieval and Reusing Process

In Figure 4, a user is searching for suitable journal papers by filling in data on title, publisher and keyword fields on the "knowledge searcher" which is designed to be used as a search interface for the KMS at the library of University A. Since the KMS cannot provide journal that satisfies this query, the system begins to search other KMS including Publisher XYZ. The mappings allow the KMS of Publisher XYZ to understand the incoming query. For example, the details provided in the title, publisher and keyword fields on the search interface are similarly referring to the concepts journal, property publisher and property keyword that belong to the ontology of Publisher XYZ. As long as the requested journal is available in the knowledge base of Publisher XYZ, it will be delivered to the search interface of University A.

Subsequently, the journal will be displayed as if it is retrieved from its own knowledge base. In other words, the entire inter-organizational knowledge retrieval and displaying mechanism are performed in a "black box" manner.

CONCLUSION

The organization based KM approaches have caused collaboration problem in which organization is not capable of reusing inter-organizational knowledge even though the required knowledge is available in knowledge bases of other organizations. An ontology-based collaborative inter-organizational KM network is proposed to solve the problems. To establish the network, a selection framework is proposed to assist organizations in choosing suitable ontology mediation approaches, ranging from mapping approaches, levels of automation, mediation methods to matching techniques. The knowledge reusability and mismatches reconcilability of ontology and its related mediation methods enable organizational KMSs to understand the incoming request and the return knowledge, thus making it possible for them to collaborate and communicate with each other. By annotating knowledge explicitly in the form of machine processable representation, organizations joining the network can access, retrieve and reuse domain specific inter-organizational knowledge to support the five stages of organizational KM process. While knowledge engineers could reuse inter-organizational knowledge to create and evaluate organizational knowledge, general users are benefit from the effectiveness and efficiency in searching for relevant inter-organizational knowledge within the network.

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REVIEW: INTERDISCIPLINARY RESEARCH OF OPTIONS THEORY AND MANAGEMENT INFORMATION SYSTEM

ABSTRACT

First applied in the finance field, Options Theory (OT) has now been applied successfully in a several other fields. OT is well suited for applications in the Management Information Systems (MIS) field. In the last two decades, MIS researchers have used OT in many discrete cases; however, the theory still holds great potential for other MIS applications. The purpose of this article is to review research on OT in the Management Information Systems (MIS) field. The paper reviews OT and suggests further ways it may be useful for MIS. Several directions for future research are advanced, and questions for future inquiry highlight what is known and what needs to be learned. The paper explores current global trends and past uses of OT by MIS researchers within a framework. Our objective is to broaden discussion of OT in the MIS field, facilitate theory development, close gaps in existing knowledge, and uncover areas where research is needed. We believe that MIS researchers will benefit from our study.

Keywords: IT investment, Options theory, Review

INTRODUCTION

Since the 1970s, Options Theory (OT) has emerged as an important tool in the finance field. Besides being used for evaluating investment opportunities, it has been extended to analyze many critical issues, such as managerial behavior, and partnership dynamics. It has also been used successfully in many disciplines such as psychology, engineering, and general management. Because OT provides a perspective by which we may assess managerial behavior, MIS researchers have also shown a steadily increasing interest in the theory because of the way it can explain many specific context phenomena.

However, despite the importance of OT to MIS research, there has been surprisingly little research using a framework to plot global OT research. This lack of a framework for global interdisciplinary theory may confuse some MIS researchers because they may not perceive how their work fits the context of a global framework. Thus, the lack of a global view may hamper the development of OT in the MIS discipline. For these reasons, a comprehensive framework is long overdue.

The purpose of this paper is to bridge this gap. We present a comprehensive survey of OT literature in the MIS field, explain the relationships between previous studies, and present a detailed framework of previous works that brings together disparate streams of thoughts. It is hoped that the framework will give researchers a better understanding of the role of OT in MIS. Moreover, we make several suggestions for future research.

The remainder of the paper is organized as follows. First, we introduce OT, and explain why the theory has such vital relevance to MIS scholars. Second, we present a typology of OT and then

describe, compare, and contrast the modules with each other. Third, we propose a comprehensive framework that represents current knowledge and areas that require further investigation. Finally, we turn to a discussion of several major considerations that MIS researchers need to address when applying OT in MIS studies.

Options Theory: Overview and Basic Concepts

It was not until the late 1960s that the breakthrough Nobel Prize winning works by Black and Scholes (1973) and Merton (1973) provided a rigorous way to price options. Based on Ito Calculus and the concept of dynamic portfolio hedging, the derivation of a differential equation with the value of a call option for determining the boundary conditions resulted in the now famous closed-form Black-Scholes formula. Their outstanding work created a new paradigm of derivatives pricing, and resulted in the rapid development of option pricing and interdisciplinary financial engineering. Since that time, a variety of derivative pricing models, such as the binomial model by Cox, Ross and Rubinstein (1979), have been developed. Hull (1998) provides a non-technical introduction to options pricing theory.

Option pricing theory has been applied in many areas. An option is defined as the right, but not the obligation, to take investment action on a real asset at a predetermined cost, called the exercise price, for a predetermined period of time. Myers (1974) first recognized that option-pricing theory could be applied to real assets and non-financial investments. OT offers a new and more realistic way to value strategic opportunities and uncertainty, because traditional valuation methods, such as Net Present Value (NPV), do not provide values for strategic investments and uncertainties. In contrast to NPV, Options Theory manifests as a collection of call options or put options embedded in capital investment opportunities.

Myers considered that discretionary investment opportunities, such as those presented by growth options, capture the real value of a project. By making a primitive phase investment, a project is implicitly equivalent to buying an option. The option holder has the right, but not the obligation, to exercise an option. Thus, the option's payoffs are asymmetrically distributed due to the limited liability of the option. By their nature, options create an asymmetrical payoff. In essence, they shift the possible distribution toward a more favorable pattern.

The idea of applying OT in strategic capital budgeting and valuing opportunities marks a second revolution in options theory. Following the progress made by Myers, Kester (1984) and Dixit and Pindyck (1995) suggested the use of option-based techniques by which managerial flexibility, implicit in investment opportunities, could be valued. They stressed the importance of the irreversibility of most investment decisions, and the ongoing uncertainty of the environment in which these decisions are made. Kulatilaka and Marcus (1988) also discussed the strategic value of managerial flexibility and its option-like properties. Trigeorgis (1993) used this theory to deal with features and problems associated with the valuation of projects. In addition, many useful OT valuation techniques, described by Copeland and Antikarov (2001), have been demonstrated as alternative techniques for decision-making and valuations.

It was not until the extension of options theory to real assets that the door was opened to opportunities for other fields. Derived from the pricing of financial options, researchers

discovered many new ways to use the theory. OT is also applicable to options comprised of "real opportunities". In addition to theoretical development, applications of OT are growing fast for tasks like business strategy design, capital budgeting, making decisions about entering new markets, and contract negotiations. OT has been applied in several areas, ranging from natural resources development, real estate, R&D, and pharmaceuticals to manufacturing, and government regulations. Because of the MIS field's unique characteristics, many MIS scholars have discovered that a number of context-unique problems, such as how to value strategic IS/IT investments, can be re-examined from the perspective of OT.

Many of the properties inherent in MIS can be interpreted as different types of options. For example, MIS managers and designers face a common difficulty in that most IS/IT projects are inherently risky and uncertain, both financially and technologically, especially so given the rate of change in high technology and our deregulated economy. Consequently, solid methods for valuing prospective investments are necessary so that development strategies may be justified. In such an atmosphere, we must consciously manage risk, and we can do so most effectively by developing options that may be exploited depending on future possibilities. To summarize, OT provides a way of thinking that enables several kinds of flexibility, which we describe in the next section.

Research Methodology

Our methodology for identifying OT studies proceeded in three stages (Webster and Watson, 2002). First, using key words, we queried journal databases. We reviewed articles published in periodicals from 1980 to the first part of 2005 and browsed the titles of articles in leading journals and conference proceedings (1974 through 2005). Journal databases included the ABI/INFORM database. Articles were selected if they satisfied the following criteria: 1) OT is applied in the MIS field; 2) The research methodology is well described; 3) The research results are available and complete.

The journals found in the ABI/INFORM database were:

- MIS Quarterly
- Communications of the ACM
- Decision Support Systems
- Information Systems Research
- Journal of Management Information Systems
- Management Science
- Communications of the AIS
- Harvard Business Review
- Management Science
- Sloan Management Review
- Information and Management

The next step involved a search of bibliographical references for various articles on options and related topics. As suggested by Webster and Watson (2002), to ensure variety in our search scope, our methodology covers relevant literature on the topic and is not confined to one research

methodology, one set of journals, or one geographic region. Since the MIS field draws on several reference disciplines, such as computer science, management science, cognitive science, and organizational behavior, some articles that focus on issues of interest to these disciplines could be considered part of the MIS literature at some level of abstraction. We used the Social Sciences Citation Index and the Web of Science to identify additional candidate articles. The decision to include these additional journals was based on two reasons: 1) several journals known to publish OT articles were not included in the ABI/INFORM database; and 2) many of these additional journals are recognized by MIS experts as being important to the field of OT. Each of the following journals was manually searched for the same 31-year period.

- Journal of Finance
- Journal of Financial Economics
- Journal of Financial and Quantitative Analysis
- Journal of Financial Economics
- The Quarterly Review of Economics and Finance.

To ensure the reliability of the final list of included articles, we required each article to be peer discussed. On all included articles, agreement was made by at least two reviewers. For approximately 75 percent of the articles, there was agreement on the selection by all three reviewers. Each article was then discussed until there was agreement on which articles should be included in the final set.

A Framework for Analysis of the Role of OT in MIS

In this section, a comprehensive framework is presented to help MIS researchers better understand how to apply OT more rigorously, identify the discrete development and critical knowledge gaps, and guide future research. The key assumptions and questions when applying the OT technique are described at the same time. Our framework is placed on a hierarchy for clearly identifications of the relationships among previous works. (See Figure 1)

To formulate problems related to IT investment opportunities, two models have been used to describe uncertainty and model the evolution of strategic opportunity processes, i.e., the continuous-time model and the discrete model, as shown in Level 1. The discrete model, developed by Cox, Ross and Rubinstein (CRR, 1979), subdivides continuous time into discrete periods; underlying asset movements can be described within specific time slots. Following the CRR research, Trigeorgis (1993) developed a lognormal, meaning the logarithm of the price has a normal distribution, transformed binomial tree that applies to stock prices. The strength of the two models lies in their simplicity, and they are good models to use when dealing with a small number of tree levels. The CRR model and the lognormal transformed binomial tree are the two most important discrete models that have been used to describe uncertainty in the OT field, as shown in Figure 1.

Although discrete models are excellent tools for option pricing when a multitude of vague information needs to be taken into account, they do have inherent shortcomings resulting from the complexity of a discrete formula increasing exponentially as the number of iterations increases. Fortunately, with the advance of computers, complex calculations can be performed,

despite these conditions. A well-structured spreadsheet algorithm may aid complicated calculations greatly. For this reason, most people utilize a discrete model to solve problems that consider simple options.

The simple evaluation method provided by these methods results in implications for management. Managers are in favor of a simple evaluation method that can help them make decisions. However, problems with more complex options, for example, a path-dependent tree such as a switch option and a compound, or recombination problems caused by a jump in underlying asset values, cannot be evaluated by these discrete methods. Thus, in Figure 1, we can see that these options are not available for the tree model panel.

[Figure 1 here]

Continuous-time models provide a way to overcome these problems. Based on the argument of an arbitrage expression, a partial differential equation can be derived, the solution of which gives the value of a call option. The actual equation used may be the well known Black and Scholes formula. Dixit and Pindyck (1994) derive their outstanding work by using the derived Partial Differential Equation (PDE) instead of constructing a discrete tree. The benefit of continuous-time models is that the different options have similar PDEs, and we just need to apply some specific boundary conditions for the PDE to be solved. This property makes it easier to apply the continuous-time models to MIS instances.

Because options models depend on some specific assumptions, their appropriateness should be determined, according to different scenarios. There are several models by which the movement of the underling assets of options may be described. Standard Brownian Motion is one of the most fundamental notions of stochastic process modeling, and it forms the basis of modern options theory. In a Geometric Brownian Motion process, the price of an underlying asset is described as a diffusion process with a drift rate; while in a jump process, the price may increase or decrease sharply because a sudden event, such as a major success in R&D or the failure of a lawsuit. The Mean Reverting Motion Process describes an average characteristic, such as one that fluctuates according to a seasonal effect. We identify three motions of underlying asset value in level two in Figure 2.

[Figure 2 here]

At the next level, Level 3, we must distinguish and clarify what options are present. The six types of flexibility in the OT literature studied by Trigeorgis (1993) are partially mapped and extended at this level. Types of options include: 1) the growth option, which occurs when an early stage investment is used for follow-up investments (Majd and Pindyck,1987, Pindyck,1988, Taudes,1998); 2) the option to abandon a project if it is unsuccessful, which occurs if the market conditions deteriorate severely, and allows the management to abandon current operations and recoup the salvage value of capital equipment and other assets (Myers and Majd, 1990); 3) the option to switch an input mix or output mix (Kulatilaka, 1993, Kulatilaka and Trigeorgis, 1993); 4) the option to alter the operating scale, which provides the flexibility to expand or contract a

project's scale (Pindyck, 1988, Kogut, 1994); 5) the option to abandon enables a company to cancel a project midstream if the business environment changes dramatically. (Keil, 2000); and 6) the compound option, for options interact in various ways, the value of the interacting multiple options is not equivalent to the sum of the individual options. These options must be carefully reconfigured before making strategic decisions (Trigeorgis, 1993).

Moving to the next level in Figure 1, there are two ways to determine option value. The first is the analytical solution, and can be seen in examples such as the Black and Scholes Formula, where, under their assumptions, the value of the option depends on the current value of the underlying asset, the exercise price, the instantaneous risk-free rate, the variance of return of the underlying asset, and the time to exercise the option. Additional research into model development includes the works by Brennan & Schwartz (1977), Kester (1984), McDonald & Siegel (1986), and Paddock & Siegel & Smith (1988). The models developed by Margrabe (1978), McDonald and Siegel (1986), and Carr (1988) provide well-known analytical solutions.

We can only apply the formula to a case directly if the problem suits the assumptions. However, for some types of options it can be difficult, even impossible, to find an analytical solution to the differential equation. In such cases, it is necessary to apply numerical methods that estimate the value of the option. Many methods have been proposed to tackle the option-pricing problem numerically. They can be divided into three main classes: finite difference methods (first introduced by Brennan & Schwartz (1977); Monte Carlo simulation methods (introduced by Boyle (1977); and lattice methods first proposed by Cox, Ross and Rubinstein (1979). In the next section, we will discuss MIS research, methodology and problems focused upon, identify the position of the research within our framework, and, most importantly, identify gaps in MIS research that would be good territory for future study.

Options Theory Research in the Management Information Systems Territory

Options Theory (OT) is especially valuable for projects that involve both a high level of uncertainty and opportunities to dispel that uncertainty as new information becomes available (Copeland, 2001). Since decisions made in the implementation of IT projects are contingent on unknown future states, OT is suitable for redefining decision-making behavior via strategic business thinking. In the context of implementing large IT projects, it can help resolve uncertainty by creating preliminary modules or prototypes; or it may help in the development of an infrastructure that increases future competency. These options generate additional value in terms of managerial flexibility because they enable managers to make decisions until the uncertainty factors are resolved. As a result of the direct applicability of OT, most MIS researchers focus on capital budgeting in the MIS context.

MIS researchers have long recognized the fact that many IS/IT investment projects possess uncertain, option-like characteristics. Some researchers have applied OT to IT investment decision-making (Dos Santos, 1991, Clemons, 1991, Kambil et al, 1993). Taudes (1998) showed that OT can used to evaluate software growth options as a sequential exchange option for a SAP R2 upgrade problem. In 1987, the options focus was used in an analysis of the timing of the deployment of point-of-sale (POS) debit services by the Yankee 24 shared network of New England (Benaroch, 1987). Later, Benaroch (2000) employed a version of the Black-Scholes

option-pricing model to obtain reliable values for Yankee 24's investment timing option. Other research emphasizes that it is important to understand and hedge risks in IT projects based on OT (Kumar, 2002). Benaroch (2002) illustrates how OT can be applied to an IT investment that entails the establishment of an Internet sales channel. Finally, Balasubramanian (2000) and Sambamurthy (2003) emphasize the application of options thinking to business strategy to facilitate agility. Next, we discuss how the relative positions of each of these research studies fits into our framework.

At Level 1, because the option value is context dependent, different assumptions must be appropriately set to fit different problems. We see the economy that PDEs or tree models provide when they are used in formulating problems, but note that *most* MIS researchers use analytical solution formulas to solve PDE problems. There have been few attempts to develop context-specific models, except for Campbell (2002), who attempted to exploit the certainty of early cash flows by providing a rationale for the early exercise of an investment option. *Still, no* MIS researchers have yet attempted to model options characteristics on their own with continuous-time models. Instead, they resort to ready-to-go close-formed formulas, such as Black and Scholes' approximation, when modeling investment opportunities as options with uncertainty.

Further discussion is warranted. Because the options models were developed based on specific assumptions, factors dealing with their appropriateness should be scrutinized for different scenarios. Although there are standardized models, such as the well known Black and Scholes formula, which can be used to calculate option values, analytical models only provide solutions to general form cases and are not suitable for broad applications. Thus, direct application of Black and Scholes formula or other closed-form formulae is inappropriate for contextual problems. For example, in a multi-stage IS/IT investment project, the options are interdependent, resulting in a compound option (Trigeorgis, 1993). Interactions generally depend on several characteristics: the type, separation, degree of being "in the money" or "out of the money"; the order of the options involved; and factors that impact on the joint probability of the model. The cumulative effect of options dictates that the value of individual options in a series of cascading options may be reduced, or enhanced, by interaction with other options, i.e., individual options can contribute value in a substitutive, additive, or complementary way (Benaroch, 2002). For more sophisticated options, however, these standardized methods are not helpful and more advanced approaches are necessary (Geske and Shastri, 1985, Trigeorgis, 1993; Perlitz et al, 1999).

In Level 3, we identify three motions of underlying asset value. Most previous works have focused on the standard Geometric Brownian Motion Process, in which the price of an underlying asset is described as a diffusion process with a drift rate. In many MIS related problems, we see a number of underlying asset price movements that behave like a jump process, i.e., the price increases or decreases sharply because of a sudden event, such as a major R&D success or a failure brought about by a lawsuit. Moreover, few previous works have focused on the Mean-Reverting Motion Process, used to describe a characteristic, such as seasonal effect in revenues for a high-tech company. Future studies should describe asset price evolution using a dynamic model to model the real world settings.

In level 4, as we argue through systematic analysis, the characteristics of MIS tend to require a close-form formula. Analytical solutions are derived based on specific assumptions and are limited by their applicability. For example, the Black and Scholes formula offers a simple method of options pricing, but it is derived from the simpler European option, not the compound American option. Hence, it cannot deal with compound options. Moreover, the model is limited to a single factor of uncertainty.

We further investigate research issues among studies of OT in an MIS context (See Table 1). The review of literature in this area reveals that most applications of OT have involved projects with well-defined risk characteristics. Studies range from a focus on active management (Kumar, 2004), to evaluating investment in new information technologies with concepts from OT (Dos Santos 1991, Kumar 1996), and capital budgeting.

[Table 1 here]

Among the issues discussed, we can see that, for MIS, option pricing theory has been used primarily for capital budgeting. The main emphasis of OT research concerns the inability to properly measure the costs and benefits associated with a specific information management project. Many authors have used OT to deal with problems associated with the valuation of projects that exhibit flexibility, resulting in a number of papers that concern valuation. Table 1 lists the range of applications covered by these studies. Though volumes of MIS research have been produced, it is notable that, in the MIS field, more realistic modeling of uncertain factors that apply to real world cases has been neglected. Figure 1 shows our framework, in which each leaf node indicates a potential direction for future research. Because of the narrow focus of most MIS research in the past, there are many areas still to be researched, and these are accorded a place in the framework. Developing flowcharts for different corporate investment decisions and projects for management to utilize is important for MIS efforts.

In addition, the application of OT to a broader set of issues is another missing component of the current efforts in this area. More effort is needed to uncover a good analogy of OT in MIS contexts. Keli (2000) made an outstanding cross-cultural study of the escalation of commitment behavior in software projects. Such attempts of drawing OT to explain MIS phenomenon is a valuable try.

A more important finding is that the number of empirical articles exceeded the number of non-empirical articles that focus on purely conceptual work. Empirical research includes such as that Quigg (1993) conducted an empirical test of options pricing models, while Bendoly and Kaefer (2004) conducted an empirical study on the strategic timing of ERP on B2B e-commerce technology efficiencies. MacDougall (2003) empirically examined four manufacturing technology investments.

Using OT in Future Research

Further research in the area of OT should focus on case surveys, demonstrating to industry how OT fits and improves evaluation models. It would be exciting to look into building OT into MIS, and develop a general methodology to evaluate flexibility in the future.

The first of several considerations arises as a result of possible bias in the selection of papers from various reference disciplines and journals. Despite an extensive approach, the selected sample is not exhaustive. Expanding the sample to include journals outside mainstream MIS or relevant OT research could provide a valuable view of the role of OT in MIS that would otherwise be missed.

Second, though awareness of using OT is growing among MIS researchers, the number of papers available on the subject is limited. Further research that MIS applied OT would surely progress within the bounds of the current research framework. Years from now, the current situation can be critically analyzed. Directions for future thinking, made to further past research efforts and prepare for future researchers, based on the review of existing scientific articles, can bridge gaps in knowledge.

OT can provide a potential service to the MIS field, as illustrated in Figure 3. The figure combines the supply chain concept with the components of the information infrastructure of a firm. Information infrastructure, specifically for MIS projects, consists of hardware, software, applications, and networks (Laudon, 2004), and needs to be efficiently managed in order to achieve a competitive advantage.

“Hardware” expenditure invariably requires critical capital budget decisions, as the expenditures for hardware will be massive, and are made in an uncertain business environment. As stated earlier, OT is best suited to capital budget decisions, such as those made for the hardware infrastructure of a firm. Therefore, it is critical that OT be applied to MIS, resulting in clarification of the option to abandon a project, and the option to implement timing decisions.

OT can also contribute to the “software” component because of its ability to analyze the flexibility value embedded in the software upgrade decisions, and the decision for outsourcing. IS/IT human resource management can apply switch options to analysis the value of recruiting permanent or temporary staff. The “applications” can benefit from the OT thinking by setting application portfolio priorities according to a project’s benefits and uncertainties. This is very different to traditional thinking, which only considers the benefits of projects. In addition to the above components, OT can help companies re-think their strategies, such as software reuse with a new perspective of flexibility value. Traditionally, expensive alternatives in capital budgeting will be discarded even it may bring future flexibility. OT demonstrates that as long as the flexibility may contribute to the expensive project in the future, the project is worth undertaking. Moreover, OT can help explain the phenomenon that most software debut with imperfect bugs version to acquire market share as soon as possible and improved in future versions rather than debut a flawless but time-consuming version.

[Figure 3 here]

In addition to applying to inside an organization, OT thinking contributes to strategic management in supply management. The strategic relationship cannot be explained with tradition tools, such as NPV. A company can evaluate the value of partnership with its suppliers. Using option to switch can help the management to evaluate flexibility. In addition, OT helps make more efficient contract between the company and its supplier by risk sharing. For example, a contract with a flexible order quantity may be designed to solve the problem of over-stocking under uncertainty. A company can change the scale of production, and switch the output mix to its customer under environmental uncertainty. In summary, applying OT thinking contributes to exploring the relationships between nodes in the value chain, each of the components provides future research issues for companies to gain more competitive advantages over competitors.

So far, we have discussed how OT can be applied by a single company. We now examine the potential applicability of OT from another perspective, that of different levels of competition. Next, the industrial concept of markets is introduced. We consider three different levels of competition: monopoly; duopoly; and complete competition.

- A monopoly is observed in Figure 4 when we consider only the area in the figure that is within the smallest square dotted line, and ignore the remainder of the figure. Within this small area, there are no competitors to the firm. No competitor payoff exists in this condition. The company can make decisions independently as there are no others.
- A duopoly is illustrated by the area within the medium square dotted line. There are only two firms, Firm A and Competitor B, and no external competitors in this condition. A payoff chart for competitors can be made in this condition. Firm A and Competitor B affect each other. Each company can best compete if it considers the strategy of the other. It is a two-person game.
- Complete competition is illustrated by the entire figure. There are many firms, including Firm A, Competitor B, and Competitors X, Y, and Z. All the firms in the industry affect each other. It is an n-person game.

[Figure 4 here]

The impact that a firm feels from the external environment varies according to the intensity of the competition in the industry. OT studies in MIS have focused on a single company's opportunity. In reality, however, most opportunities are shared; therefore, a company faces competitive forces that result in a dynamic equilibrium. It is critical to evaluate the strategic value of competitive markets, especially in the fiercely competitive IT sector. In contrast, a firm with a monopoly only needs to consider how long it should defer its strategy opportunity to maximum option value, rather than to consider its competitors.

A rigorous framework addresses the manifold problems that arise when making decisions such as investments under conditions that include uncertainty and competition. Previous OT models categorically assume a monopolistic or perfectly competitive framework. These OT models do not allow for strategic interaction, and assume generally inappropriate conditions, such as

symmetric uncertainty, in investment opportunities. The opportunity can be configured rigorously to the MIS context.

When one degree of competition arises, it is a duopoly; in a more competitive environment, all market players share the value for the market opportunity. Traditionally, two approaches have been used to deal with this issue. One approach models the competitive entries as exogenous shocks. For example, Dixit and Pindyck (1994), Trigeorgis (1991, 1996) and Li (2002) use a Poisson Jump Process to describe the arrival of a competitor in the market. Another approach used is the application of game theory, a Nobel Prize winning work advanced by Nash (1950). Smit and Ankum (1993) extended game theory. Game Theory and OT form an excellent combination for evaluating IT strategy, a combination that may change the face of information economics. Game Theory describes inter-player strategies, and OT justifies the actual value of the feasible strategies described by analyzing payoffs. The first attempt to model external competition, using an estimated entry or a random entry of competitors, was made by Kim and Sanders (2002). Game theory concepts, including strategic interaction between firms, have not been addressed in OT models for the IS/IT industry.

Future MIS researchers must be able to assess the impact that a change makes in accordance with the many unique characteristics inherent in MIS. Technology investment often occurs in conditions of uncertainty, with externalities and in contexts of preemption. Moreover, many long lasting phenomena in MIS can be re-examined, such as: timing of the debut of software, regardless of bugs; problems in supply chain vendor switches; and negotiations between several parties in contracts.

Since OT assesses the value of strategy flexibility, decisions are examined each time new information arrives during the deferral period. As OT optimizes investment strategy in light of new information, it should play an important role in MIS.

Summary and Conclusions

OT has been accepted in many fields because it provides a useful way to understand the value of strategies and opportunities. As a result of OT research, progress has been made in various fields, including patents, investment decision practices, and knowledge management.

The use of OT in MIS is still young. The discussions, issues, and ideas set forth in this paper should stimulate interest in incorporating OT in the field of MIS. Based on the use of OT in existing MIS research, the paper presents an analysis of how OT has been used on a broad range of relevant literature. The paper provides the following guidelines for researchers:

1. An overview of OT for those who wish to understand and use the theory in MIS research. Different perspectives and taxonomies of knowledge are reviewed and discussed, and ideas from diverse research are integrated into a framework.

2. The paper identifies proper application of OT, thus enabling effective development. It seeks to build awareness and understanding of significant works in the field, providing a diversity of perspectives and approaches to MIS and more specific research of OT.

3. It help future theorizing and makes research suggestions regarding OT and the MIS field based on past research, thereby forming a potential basis for future research.

We suggest two ways that OT may play a part in future MIS applications. Implementation is a tradeoff between easy of use and precise brought by complicated modeling and calculating:

1. Offer a simple implementation procedure to help make strategic decisions. Friendly packages can be prepared for ease of use, and powerful computers can allow sophisticated models to be built. This reduces criticism of OT for its complex mathematics.
2. Incorporate realistic risk factors in modeling MIS. The more risk factors used to describe uncertainty, the more complex it will be.

From this review, it is evident that the rich discussion regarding OT applications that took place in the field of financial economics has extended to the unique MIS context, but not fully. The potential benefits as well as the methodological problems in applying options pricing theory in R&D project evaluation merit further consideration. Case studies and empirical studies will play a crucial role in justifying more real-world MIS applications.

The ultimate effort is to develop simple and precise pricing formulas for unique MIS context formulating and to develop a powerful decision support tool. No matter what method is adopted, OT is an excellent tool that will certainly have a place in future MIS applications.

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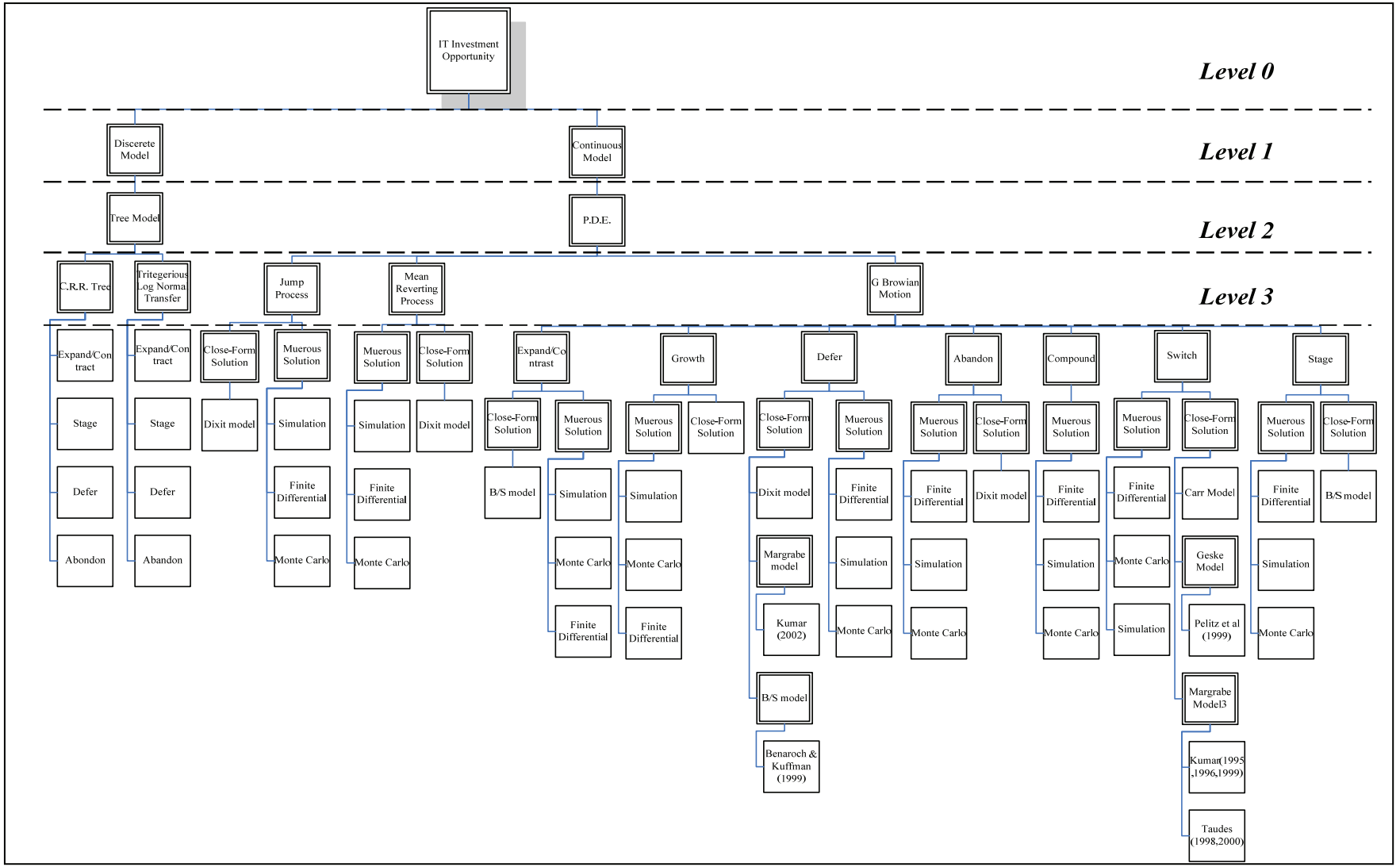

Figure 1. Research Framework

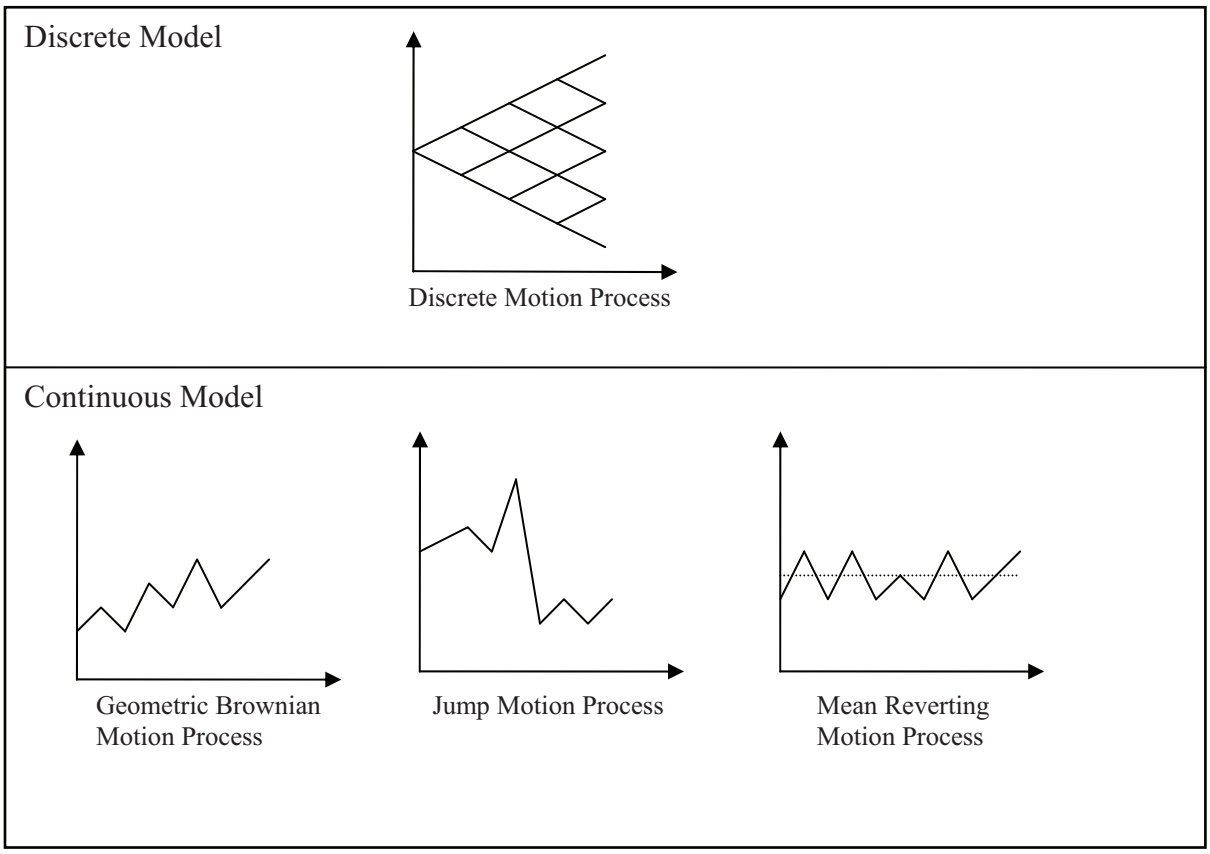

Figure 2 Various Continuous Motion of Underlying Asset Value

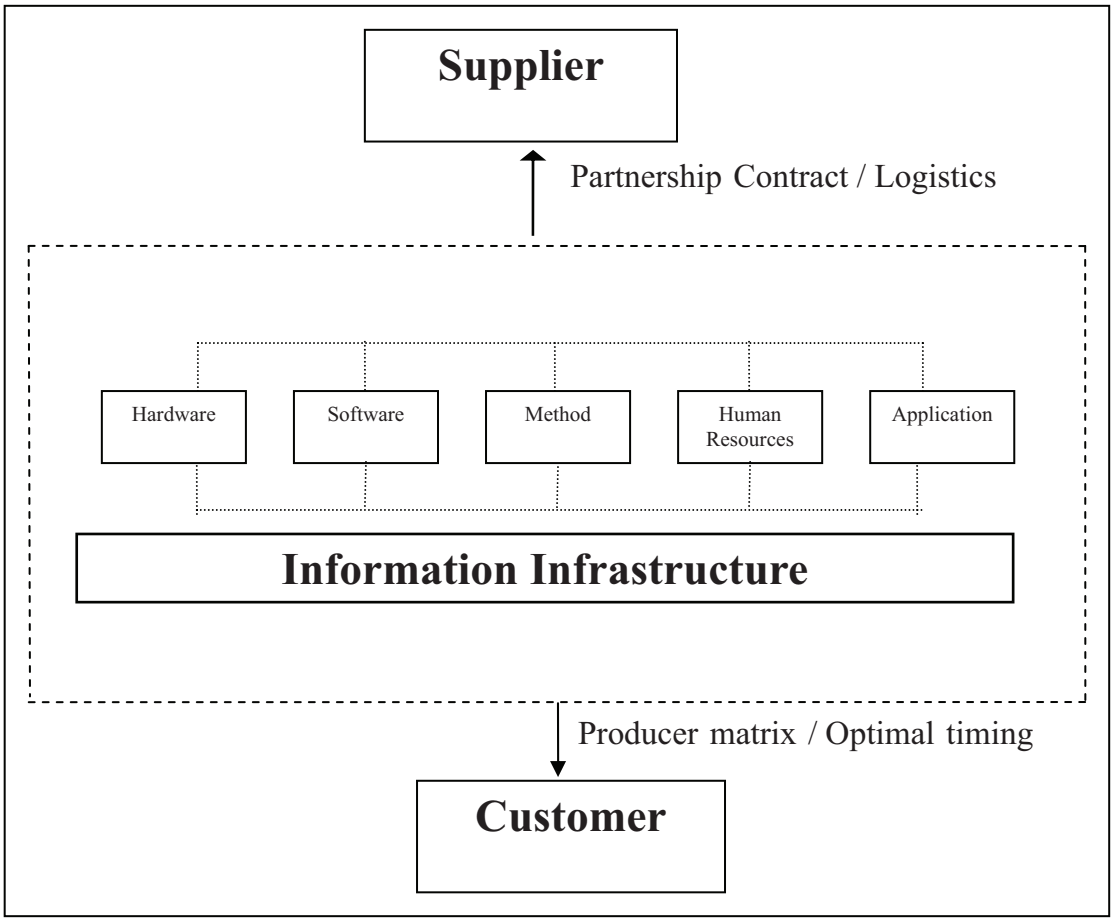

Figure 3: Potential OT applications

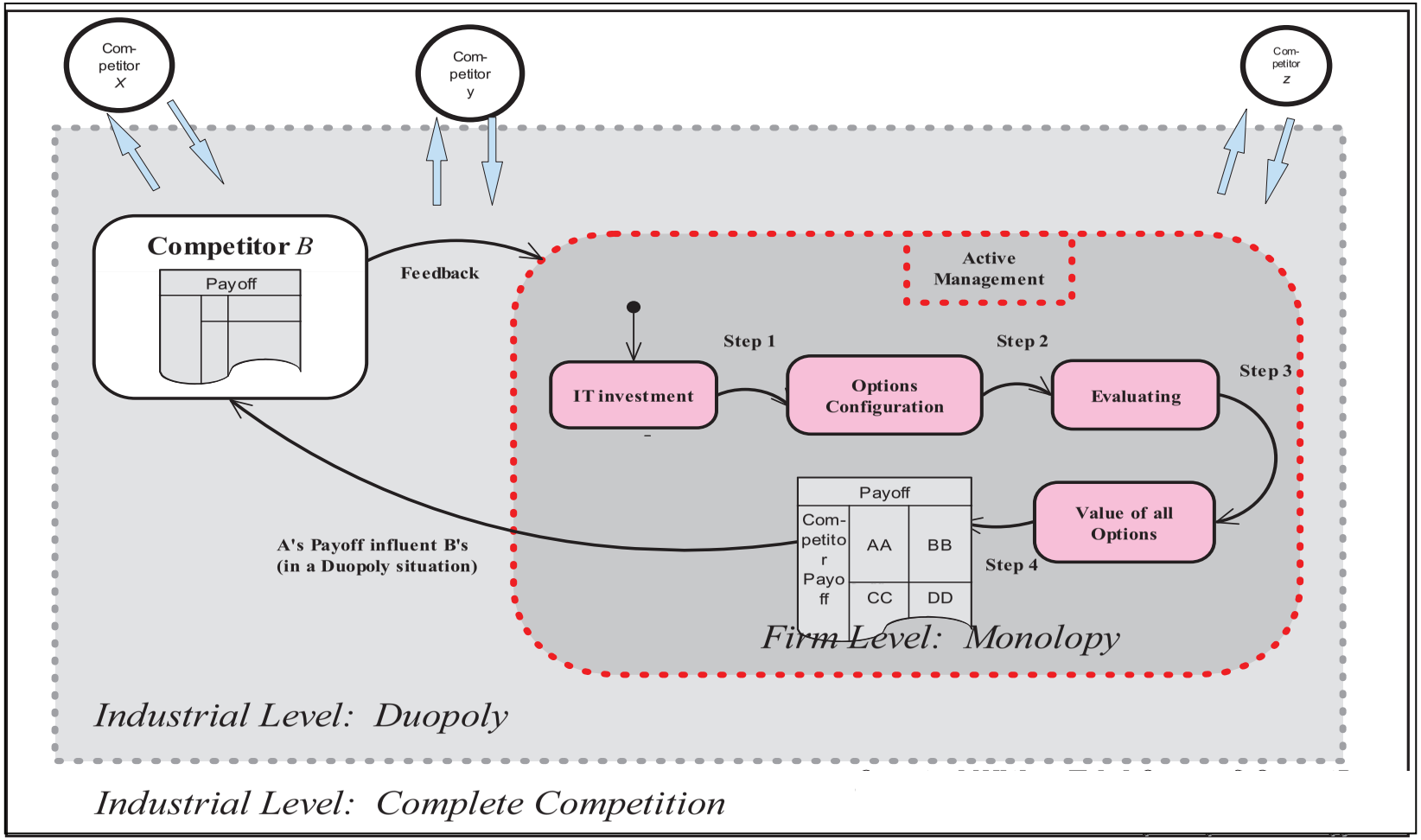

Figure 4 OT potential- Another viewpoint on levels of competition

Table 1 The taxonomy of Options

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A CLASSIFICATION MODEL OF ERP SYSTEM DATA QUALITY

Anders Haug, University of Southern Denmark, Denmark
adg@sam.sdu.dk
Anne Pedersen, University of Southern Denmark, Denmark
ape@sam.sdu.dk
Jan Stentoft Arlbjørn, University of Southern Denmark, Denmark
jar@sam.sdu.dk

ABSTRACT

Implementations of ERP systems have been reported to provide a number of benefits for many companies. However, several studies also illustrate that achieving such benefits from the use of ERP systems can be difficult. In this context, one of the main challenges is to ensure adequate quality of the data in the ERP system. To support the evaluation of ERP data quality and to improve the understanding of data-related problems, this paper proposes a classification model of ERP data. The proposed classification model builds on a discussion of existing data quality classifications. The relevance of the classification model is illustrated by presenting three case studies where ERP data issues have been studied.

Keywords: Enterprise resource planning, ERP systems, Data quality, Master data management

INTRODUCTION

It is a widely accepted maxim that decisions are no better than the data on which they are based. Data are fundamentally important for all companies, since almost any activity in a company requires data. To be more specific, data are created and used in all daily operations, data are critical inputs to almost all decisions, and data implicitly define common terms in an enterprise, which makes data a significant contributor to the organization culture [10]. Therefore, it is of critical importance that data are of adequate quality. According to Redman [15], studies to produce estimates of the total cost of poor data quality have proven difficult to perform, but at least three proprietary studies have yielded estimates in the 8-12% of revenue range. However, Redman [15] claims that, informally, 40-60% of the expense of a service organization may be consumed as a result of poor data. Häkkinen and Hilmola [6] argue that marginal data inaccuracies (e.g. 1-5%) may not necessarily represent a major problem in manufacturing, but that such inaccuracies will have direct effects in terms of lost sales and operational disruptions in the after-sales organizations.

A typical source of data quality problems is that the same data are stored and maintained redundantly in different systems. Vayghan et al. [22] argue that normally large enterprises manage data at a local level (e.g. department or location), which results in the creation of 'information silos' in where data are redundantly stored, managed, and processed. Thus, inconsistency often occurs. Mohania and Bhide [12] claim that the information integration problem has become the biggest pain point for enterprises today. According to Mohania and Bhide, the growth of organizations invariably leads to creation of multiple isolated data sources that are disconnected from each other, leading to reduced efficiency. In this context,

ERP systems have been promoted as a panacea for dealing with lack of data integration by replacing inadequately coordinated legacy systems [2;8]. However, it is often a difficult task to implement an ERP system into an organization, and often such projects do not produce the expected benefits [3;6;11;21;26]. In this context, it has often been argued that the quality of data/information is a major determinant of ERP success [19;23;25;27;29]. In fact, it has been suggested that data problems get intensified when using ERP systems, because the ERP modules are intricately linked to each other, for which reason poor quality data input in one module can negatively affect the functioning of other modules [14].

Since it is essential for the success of an ERP project that the needed data can be found in the ERP system and that these data are of adequate quality, there is a need for continuously evaluating the ERP data, both during implementation and when using the ERP system. The question in focus of this paper is how to evaluate ERP data during these phases. Thus, this paper proposes a classification model to evaluate ERP system data. The relevance of the classification model is illustrated by presenting three case studies and relating these to the classification model. The classification model may also be applicable for the evaluation of data in other types of information systems, but to avoid additional complexity this discussion is not included in the paper.

The remainder of the paper is structured as follows: In section 2, the characteristics of ERP data and concepts of data quality are investigated. Next, in section 3, based on a discussion of relevant literature, a classification model of ERP system data is proposed. In section 4, three case studies are presented and subjected to the proposed classification model. The paper ends with conclusions in section 5.

ERP DATA

Data, information and knowledge

As a basis for the discussion of ERP data, it can be useful to distinguish data from information and knowledge. With regard to data and information, there seems to be general agreement on the meaning of these terms. Davenport and Prusak [4] define data as "discrete, objective facts about events" and information as data transformed by the value-adding processes of contextualization, categorization, calculation, correction, and condensation. Zack [28] provides the definitions "data represent observations or facts out of context, and therefore not directly meaningful" and "information results from placing data within some meaningful context, often in the form of a message". In a similar vein, Newell et al. [13] define data as "providing a record of signs and observations collected from various sources" and information as when "data are presented in a particular way in relation to a particular context of action". On the other hand, the meaning of the term 'knowledge' is far more debatable. This discussion often relates to if knowledge should be perceived as being of an impersonal and static nature versus being personal and related to action. The first perspective on knowledge can be traced back to Plato's "Theaetetus" (c.400 BC) in the form of the definition 'justified true beliefs'. In spite of some criticism of this definition, it is frequently found in contemporary management literature, however, often in softer versions, i.e. with reduced emphasis on the 'truth' part (according to Fuller [5] and Newell et al. [13]). As a representative of the personal and action-oriented view of knowledge, Tsoukas and Vladimirou [20] provide the definition: "knowledge is the individual ability to draw distinctions within a collective domain of action, based on an appreciation of context or

theory, or both". However, a deeper discussion about the meaning of the term ‘knowledge’ is beyond the scope of this paper, which, as mentioned, has its focus on data.

ERP data

In a business context, the concept of 'data' involves two interrelated components, 'data models' and 'data values' [15]. A data model is a definition of entities (classes), their attributes (properties), and relationships. An example of an entity is 'employee', which could hold the attributes 'ID', 'name', 'date of birth', 'address', etc. The employee could have a relationship to the entity 'ERP project', implying that the employee is involved in this project. The data value for the employee attribute 'ID' could be '01-77-98'. When such data are stored they become data records. Unlike other typical resources, data can be readily copied, shared and combined in many ways. Thus, compared with other resources, data presents some special challenges to be aware of, not the least to ensure that data are of adequate quality.

Vayghan et al. [22] classify the data that most enterprises deal with into the three categories: master data, transactional data, and historical data. However, it seems that 'historical data' is merely a status that the first two can obtain, rather than a category of its own. Thus, the focus of this paper is on ERP master data and transaction data. Master data are the basic characteristics of instances of business entities, such as customers, products and suppliers. Typically, master data are created once, used many times and do not change frequently [8]. In ERP systems, master data are usually used across several application modules in the transactions that are registered. Transaction data describes relevant events in a company, and each transaction record has a time dimension, a value, and references to other data. Samaranayake [16] provides a list of common transaction data and associated master data, which is reproduced in Table 1.

Transaction Data	Associated process/module	Master data involved
Planned order	MRP (Material Resource Planning)	Material master and BOM
Production order	Production order creation	Material master(s), BOM, Operations routing, Cost centre(s)
Purchase order	Purchase order creation	Material master, Vendor
Sales order	Sales order creation	Material master, Customer
Maintenance order	Maintenance order creation	Equipment, Task list, Work Centre

Table 1: Common transaction and master data [16]

Knolmayer and Röthlin [8] argue that capturing and processing master data is error-prone activities where inappropriate information system architectures, insufficient coordination with business processes, inadequate software implementations, or inattentive user behaviour may lead to disparate master data. Knolmayer and Röthlin give the example that if an employee does not find required master data within reasonable time, the employee may be tempted to swiftly create duplicate data in order to continue carrying out business tasks. Also, mistyping names, addresses, and other data fields contributes to data redundancy.

Data quality

The business data of a company can be more or less useful, depending on the quality of the data. As a basis, Park and Kusiak [14] define 'data quality' as "the measure of the agreement between the data views presented by ERP and that same data in the real world". Lederman et

al. [9] provides a more pragmatic definition of data quality as 'fitness for purpose'. However, more detailed definitions of data quality in the forms of classifications have been produced.

Ballou and Pazer [1] divide data quality (DQ) into four dimensions, as shown in Table 2. They note that the accuracy dimension is the easiest to evaluate, since this merely is the difference between the correct value and what actually was used. They argue that the evaluation of timeliness can be done in a similar manner. The completeness dimension is also relatively straight forward to evaluate, as long as the focus is on if data is complete or not, rather than how many percent complete some data is. On the other hand, an evaluation of consistency is a bit more complex, since this requires that two or more representation schemes are present in order to compare [1].

DQ dimension	Meaning
(1) Accuracy	The recorded value is in conformity with the actual value
(2) Timeliness	The recorded value is not out of date
(3) Completeness	All values for a certain variable are recorded
(4) Consistency	The representation of the data value is the same in all cases

Table 2: Data quality dimensions [1]

Wand and Wang [24] investigate data quality dimensions used in literature. They apply the perspective that lawful states of the real-world are represented as states in information systems, i.e. a mapping between relevant things of the real-world and the data in an information system. The argue that two conditions must hold for a real-world system to be properly represented: (1) every lawful state of the real-world system should be mapped to at least one lawful state of the information system; and (2) in principle, it should be possible to map an information system state back to the "correct" real-world state. Their classification of intrinsic data quality dimensions is shown in Table 3.

Intrinsic DQ dimension	Meaning
(1) Complete	Each real-world state is mapped to an information system state
(2) Unambiguous	No two real-world states are mapped to the same information system state
(3) Meaningful	No meaningless information system states; Real-world states are mapped to meaningful information system states
(4) Correct	A real world state is mapped to a correct information system state

Table 3: Intrinsic data quality dimensions [24]

Strong et al. [18] provide a division of data quality that goes beyond intrinsic quality dimensions. This is shown in Table 4. They argue that while the first three dimensions can be observed relatively isolated, representational data quality dimensions are underlying causes of accessibility problem patterns. In other words, if a representation cannot be understood by some user, then this can be seen as a form of access-limitation.

DQ categories	DQ dimensions
(1) Intrinsic	Accuracy, Objectivity, Believability, Reputation
(2) Accessibility	Accessibility, Access security
(3) Contextual	Relevancy, Value-added, Timeliness, Completeness, Amount of data
(4) Representational	Interpretability, Ease of understanding, Conciseness/consistency of representation

Table 4: Data quality dimensions [18]

Building on existing literature, Shanks [17] presents a data quality classification, which is based in semiotic theory (the use of symbols for conveying information) and includes both product-oriented and service-oriented aspects of data quality. This is shown in Table 5.

Semiotic level	Meaning	Goal of the representation
(1) Syntactic	The form of symbols rather than their meaning	Correct and consistent
(2) Semantic	The meaning of symbols	Complete and accurate at particular points in time
(3) Pragmatic	The usage of symbols	Useful and usable
(4) Social	The understanding of the meaning of symbols (different stakeholders)	A shared understanding of the representation is achieved

Table 5: Data quality dimensions [17]

Besides the four described classifications others also exist (see e.g. [7]). These are excluded based on arguments of being similar to the ones described, less recognised, or not as relevant for the purpose of this paper, i.e. to create an operational classification model for evaluating ERP data quality.

A CLASSIFICATION MODEL FOR EVALUATION OF ERP SYSTEM DATA

The purpose of this section is to create a classification model for evaluation of ERP system data. Thus, as a starting point, it needs to be defined which dimensions are relevant for evaluation of ERP data.

Discussion of data quality dimensions and categories

As discussed in the previous section, different ways of perceiving data quality exist. To start with, it can be argued that the dimensions defined by Ballou and Pazer [1] (accuracy, timeliness, completeness, and consistency) are intrinsic data quality characteristics. The debate in this context is if the 'timeliness' dimension is more contextual that intrinsic, as Strong et al. [18] claims it is. This paper takes the opposite position by arguing that at the point of time where the timeliness of some data is evaluated, this data is either up-to-date or not, and, thus, an intrinsic quality. This perspective is also supported by Ward and Wang [24] who argue that untimely data is manifested in the form of wrong, meaningless or ambiguous representations. Furthermore, Wang and Wand [24] systematically deduct four data quality dimensions with intrinsic focus (complete, unambiguous, meaningful, and correct).

The intrinsic quality dimensions defined by Strong et al. [18] (accuracy, objectivity, believability, and reputation) differ somewhat from the two previous definitions. Strong et al. do not argue for this selection besides showing how these dimensions can be part of typical data quality problem patterns. In particular the last two intrinsic data quality dimensions of Strong et al. seem to relate to the subjective judgements of users, or at least this is what the

chosen terms indicate. Since the term 'intrinsic' denotes something that is specific to an element and which is wholly independent of other elements, then this kind of use seems to contradict the term. Thus, these dimensions are not included in the understanding of intrinsic data quality dimensions in this paper.

Strong et al. [18] define the three extrinsic data quality categories, accessibility, contextual, and representational, where the latter is described as an underlying cause of accessibility problems. Strong et al. define data of poor contextual quality as data with little value added or data of little relevancy for the tasks of data consumers. Thus, contextual data quality may be perceived as a way of describing the usefulness of the data. If seeing representational data quality as a sub-area of accessibility data quality and applying the mentioned interpretation of contextual data quality, this leaves the data quality categories: intrinsic, accessibility, and usefulness.

The last data quality classification by Shanks [17] can at the first two levels, i.e. syntactic and semantic, be perceived as intrinsic data quality dimensions. On the other hand, the pragmatic and the social level cannot directly be put into this category. As defined by Shanks, measurement of data quality at the pragmatic level is done by the use of stakeholder rating, while at the social level, data quality is measured by user surveys. In an ERP perspective, the pragmatic level should not be seen as an alternative to correctness at the syntactic level. If data are stored in a way that in some contexts are useful, but the data are not correct at the syntactic level, this could imply that the data in other contexts are problematic, e.g. if statistics based on such data present a wrong picture of the reality. Instead, the pragmatic level may be seen as placed on top of the intrinsic level, as a level where the decisions of storing certain types of data are made based on the usefulness of these. In an ERP context, the social level may be seen as the level where agreements on formats and standards for data are established. Thus, this level does not contribute directly when evaluating ERP data quality, but can rather be seen as input to the ERP system management.

A classification model of data quality

Based on the discussion in the previous section, the following three data quality categories are applied for the creation of a data quality classification model:

1) Intrinsic data quality dimensions: completeness, unambiguousness, meaningfulness, and correctness (based on [24])
2) Data accessibility dimensions: access rights, storage in ERP system, representation barriers, etc.
3) Data usefulness dimensions: relevancy, value-adding, etc.

The first two data quality categories (intrinsic and associability) are the easiest to measure and/or observe, while the third (usefulness) is more difficult to evaluate because it is more subjective. Additionally, the first two categories are more critical than the usefulness category, since poor data accessibility and intrinsic data quality are factors that make some daily operations impossible, while ERP system data of little usefulness to much extent can be ignored. Thus, from an operational perspective, an evaluation of the two first categories is most important. Based on the first two categories of data quality dimensions, a two-by-two matrix can be created. This is shown in Figure 1, where it should be noted that since

companies cannot expect to achieve perfect data quality, it is generally satisfactory that a small part of data is of poor quality with regard to intrinsic and accessibility dimensions.

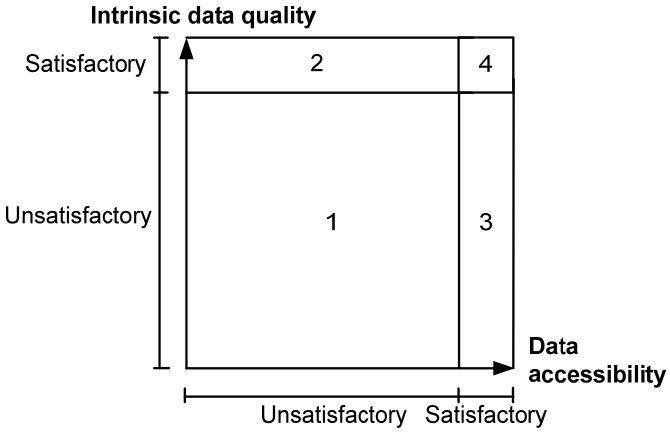

Figure 1: Intrinsic and accessibility quality of ERP system data

In area 1 of Figure 1, both the intrinsic quality and the accessibility of ERP data are at an unsatisfactory level. In such cases, the expected benefits from using an ERP system are typically not achieved, but, on the other hand, many problems are encountered. In area 2, the intrinsic quality of the data implemented in an ERP system is at a satisfactory level, but for some reason users cannot retrieve all relevant data from the system. In cases where the data are stored in the ERP system and the problem is that users cannot access this data, either because of poor knowledge of the ERP system or limited user rights, it would normally not require big efforts to fix such issues. On the other hand, if the problem is that relevant enterprise data is not stored in the ERP system, great efforts to correct this are normally required. Often the problem of not having all the relevant data stored in the ERP system is the result of the fact that some users conduct their daily operations without registering the necessary data in the ERP system. Changing the habits of such employees, therefore, is a central task. Area 3 represents a scenario where the necessary data can found in the ERP system, but the intrinsic quality of these data is unsatisfactory. This means that, although the necessary data can be retrieved, decisions based on these data may have negative effects. Area 4 represents what should be the aim of ERP projects, namely to achieve a situation where the data stored in the ERP system are of satisfactory quality with regard to intrinsic and accessibility dimensions.

Data usefulness

The three defined data quality categories allow the creation of two additional matrices, i.e. intrinsic data quality in relation to data usefulness, and data accessibility in relation to data usefulness. These two matrices and the typical patterns to be aware of (dotted arrows) are shown in Figure 2 and subsequently discussed.

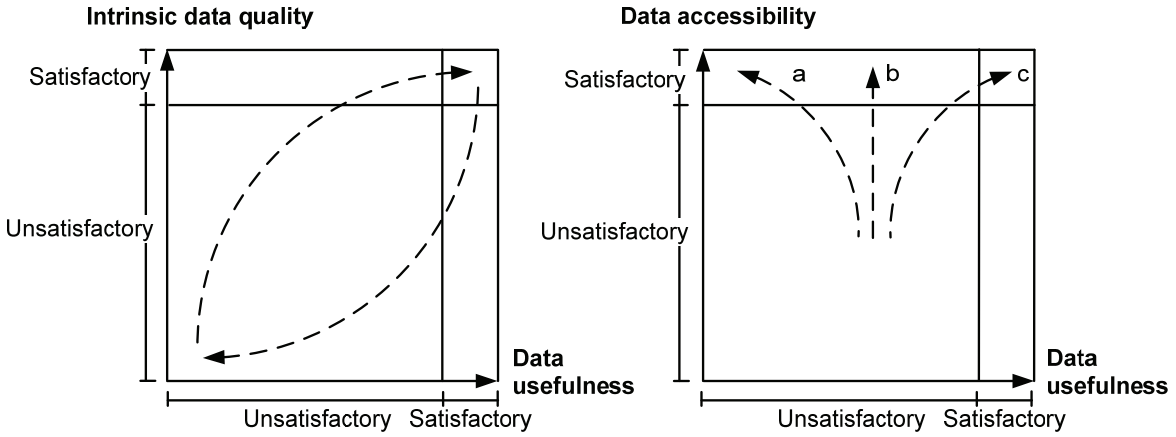

Figure 2: Intrinsic and usefulness quality of ERP system data

First, in the matrix to the left in Figure 2, from a common sense perspective, it seems that if the intrinsic data quality decreases, this would lead to more non-useful data being stored in the ERP system, because if the users begin to question the validity of data, they would also be more reluctant to use such data. On the other hand, it seems that if the intrinsic data quality is increased, this in time would imply that the stored ERP data are found increasingly useful.

In the matrix to the right in Figure 2, three typical patterns are defined. Path 'a' represents a situation where, for instance, it is decided to begin registering a new type of data, but it later turns out that this data is not used for anything after all. Path 'b' represents a situation where data are registered in the ERP system (or existing data in some way is made accessible to users), but where the increased amount of data does not make existing data more valuable and where the additional data holds a similar percentage of non-useful data. This could for instance be a situation where a field in a sales form is filled out each time an order is created, although these data are not used for anything. Path 'c' represents a situation where the usefulness of existing data is increased because of adding additional data. This can for instance be a situation where the existing sales data are not found useful for making sales statistics because of being incomplete, i.e. many sales have not been registered. However, when updating the system with the previously unregistered sales data, suddenly the existing sales data become useful for making sales statistics, because they are now part of a complete picture.

CASE STUDIES

To illustrate the usefulness of the proposed classification model, this section presents three case studies of ERP projects.

Method

In 2007, a questionnaire survey was carried out with the purpose of investigating the use of ICT (information and communication technology) in Danish SMEs (small and medium-sized enterprises). The total number of companies contacted was 182, which resulted in 95 answers. From the 95 companies that answered, three companies were chosen for more in-depth case studies. The companies were chosen randomly within the part of the companies that had implemented an ERP system, used by multiple departments in the company. Through November and December 2008, the case studies were carried out by conducting

semi-structured interviews of 3-4 hours, with subsequent questions by phone in the cases where this was needed. In each company, the managing director and a representative from either the IT department or the ERP system super-users were interviewed. The interviews were given on the promise of anonymity, for which reason the three companies are named A, B and C. Table 7 shows the overall information about the three companies.

Company	A	B	C
Turnover (2008)	~35 mill. €	~25 mill. €	~60 mill. €
Salaried staff	~60	~25	~80
Hourly paid employees	~55	~10	~120
Company type *	CTO, MTO, MTS	Wholesaler	MTO
Industry	Agriculture equipment	Insulation products	Printing solutions
ERP system	SAP Business One	Navision 5.0	SAP R3

* CTO: Configure-To-Order, MTO: Make-To-Order, MTS: Make-To-Stock

Table 7: Basic company information

Company A

Before implementing SAP Business One, company A used a less known trade-specific ERP system. By the end of 2004, company A decided to replace the old system, and the new ERP system was bought 3 months into 2005. The implementation project was planned to last three months, and this deadline was kept. The test period lasted only 14 days before taking the system into use in daily operations. During the three month long implementation project, some employees were sent on courses, and workshops about the system were held. The project preparation also included the creation of blueprints and conduction of various analyses. The ERP project manager was a person from the purchase department who had experience with the ERP system. This person received additional training in the system.

Several problems were experienced during the start of the shakedown phase. In the opinion of the interviewed, one problem was that not enough time had been spent on giving all areas of the ERP system the attention that they deserved before taking the system into use. Thus, some of the customisations of the system were later found to be superfluous, while other parts of the systems needed customisation in order to fit the business processes of the company. In all, many customisations of the ERP system were made in order to adapt the system to the company. Another consequence of the short implementation phase was that a rethinking of item-groups was not done prior to the implementation, for which reason many item-groups were not implemented in a manner fitting the logic of SAP Business One. This implied several data problems, and by the end of 2008 the company was still working on restructuring this part of the data. Besides poorly structured data, also erroneous and incomplete item master data were migrated to the new ERP system, and some types of data were not even stored in the new system because of the short implementation phase. For instance, many prices were missing. The unfortunate consequence of the poor data quality was that when making inquiries involving item data in the ERP system, the data extracted were not reliable.

At the end of 2008, the continuous work of improving data associability and quality reached a state where the data were close to being of a satisfactory accessibility and quality. In connection with this, positive effects of the project have been achieved. This includes that data are more accessible, more extensive, and of better quality, which implies improvements related to purchases, economic control, quality of the specifications delivered to customers, and certainty of delivery. In a communication perspective, positive effects have been

achieved in the form of fewer errors, fewer misunderstandings, and less time spend on communication. One of the initiatives to ensure better data quality was a decision of that it is only the technical department who have user-rights for the creation of master data for new items. However, still much can be improved. A problem that the company is currently facing is that although the required functionality for some task can be found in the ERP system, in many cases employees prefer to extract data and manipulate this data in spread sheets, e.g. for budgeting. Also, data for new items are firstly defined in spread sheets before being registered in SAP. The company has recognised that this is a problem, since this procedure results in redundant data. Thus, at the time of the case study, the company was investigating how to improve their current procedure.

Company B

Company B took Navision 5.0 into operation in January 2008. From project initiation to the ERP system was taken into use took about 2 months. Prior to this project, the company used a ten year old installation of Navision, which could not be updated. The main reason for choosing Navision 5.0 was to make the migration of data as easy as possible. During the implementation phase, workshops were held in a limited extent in order to define the new system and inform employees. However, no real education of employees was carried out. The implementation team initially consisted of 3-4 consultants, but company B found that these consultants were poorly coordinated and did much of the same work, for which reason they demanded to use only one of these consultants. Initially, the basic ideology of company B was not to let the new ERP system decide how their processes should be carried out. However, after discovering the cost and complexity of ERP system customisations, this point of view was softened and compromises were made. For instance, the company only made minor adjustments to how the ERP system defined inventory management, although originally having planned large customisations.

During the data migration from the old to the new ERP system, great problems were encountered because of poor master data. This was an unfortunate consequence of the fact that master data had not been maintained much in the old ERP system. Thus, during the two month long implementation phase, there was not enough time for reviewing data for all of their about 16,000 items. The result was that after having taken the ERP system into use, about a year was used on correcting master data, in particular related to items, debtors, and creditors. During this period, many problems were encountered because of the faulty ERP data. An effect of this was that many users did not trust the information that the system provided when generating certain reports. Thus, the use of the ERP system reports has been very limited until the time of this study.

In spite of the data-cleaning project, company B still experiences the problem that all received items are not being registered in the system, for which reason all relevant data cannot be found in the ERP system. According to the IT manager, it can be a bit tedious to register such in the ERP system, for which reason this is sometimes neglected at busy times. In this context, also difficulty in using the new system is considered to be a main barrier for data proper use. To prevent that items arrive in stock without being registered, employees in this function are controlled once in a while. Also, company B has bought customisations of the ERP system that force employees to type in certain data in order to carry out specific operations. Another problem in company B is that some item data are created outside the ERP system. About half of the item names and prices are first described in a catalogue, which

is not synchronised with the ERP system. The company recognizes that this is problematic and plans to introduce a policy where all item master data are created in the ERP system, while the catalogues are made based on exports of these data. For the financial part, the ERP system is not fully applied. For instance, although that annual accounts are created in the ERP system, these are later exported to Excel and modified. Many of these modifications are not registered in the ERP system, for which reason all such ERP system data are not reliable.

The use of the ERP system has also had some positive effects. Compared to the old system, the new system has improved features on the economic side (i.e. better reports and overviews), the system enables auto-payment to the bank (which has implied fewer errors), and the system supports electronic invoices. Also, according to the IT- manager, the new system ensures that most relevant data are registered. An indirect positive effect of the ERP project has been that many documents have been digitalised, i.e. the flows of physical papers have been minimised. However, all in all, the interviewed of company B do not think that they have achieved significant positive effects from replacing their existing ERP system compared to the resources used on the project.

Company C

Company C applies the ERP system SAP R3. Before implementing this they had been using a less known finance system. SAP R3 was taken into use in 1999 after an about 9 month long implementation phase (system configuration, system customisation, and data input). However, it took about 2½ years before the system was fully running in all areas, compared to the 1-1½ years expected at project start. Also, the budget for the project was exceeded so the project ended up costing more than twice as much as defined in the original budget.

During the implementation phase, a representative from each department was appointed, and these persons participated in common workshops where the ERP system was configured, customised, and tested. The workshops were aided by SAP consultants and held 1-2 times each week in nine months. The department representatives were given the responsibility of educating their colleagues. Both during and after the implementation, many resources were used on customising the system to make it appear like the old ERP system. The company estimates that 30% of their current ERP system is customisations.

The ERP project faced great problems in the start of the shakedown phase, which partly can be attributed to big ambitions of what to register in the system, i.e. down to ‘screw-level’. This approach made it very time-consuming to create new items, for which reason many employees took shortcuts that resulted in missing and faulty ERP data. Thus, after some time it was decided to leave out items at such a detailed level in the ERP system. Currently, the ERP system holds about 80,000 item numbers, where around 25,000 are in use. Company C considers it to have been a great problem that the consultants used for the project were too inexperienced and had too little understanding of the business processes and the needs of the company. Therefore, the first consultancy was replaced by another shortly after having taken the system into use. Also, company C experienced great problems related to master data during the first years of use. The problems relates to that master data (such as item numbers and names) were sometimes registered multiple times, while at other times all required fields were not filled out. This, for instance, made it impossible to make useful statistics based on these data. In order to solve this problem, great resources were used on training employees in proper use of the ERP system. Additionally, company C is considering allowing only central

persons to create item master data, but is afraid that this may imply waiting times when creating purchases and sales orders.

The company sees many benefits achieved from the system as it is now, but questions if the project has been worthwhile when considering the many problems and the cost of the project. Company C considers the main benefit of the system to be that data are more accessible and the quality has been increased significantly. Also, a positive indirect effect of the project has been that the company has gone from having most information only in paper form to now having almost all information stored digitally, including drawings.

Discussion

As the case studies show, all the three companies faced great problems related to ERP data quality. Furthermore, none of the three companies can at present time be said to have achieved satisfactory levels of both intrinsic data quality and accessibility. In all three cases, at initiation of the ERP project, the importance of data management was neglected, which implied great use of resources and time on correcting data. If the focus in this phase had been more on ensuring adequate data accessibility and quality, it seems that many problems could have been avoided and many resources saved. In Figure 3, the courses of company A, B, and C from the time of taking the ERP system in use until the time of the case studies are illustrated in a principal manner. As seen, the cases represent much similar patterns, i.e. cases where it at some point is recognised that the ERP data quality is unsatisfactory, for which reason many resources are used on raising the intrinsic data quality and the data accessibility.

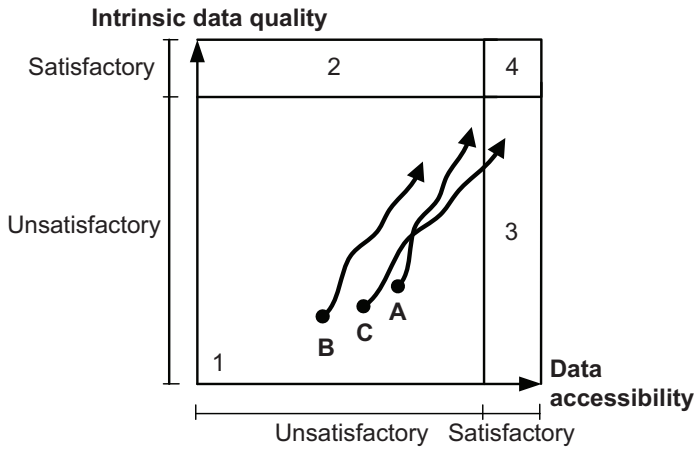

Figure 3: The development of ERP data quality in the three case companies

The three cases to some extent confirmed the claimed relationships between data usefulness and intrinsic data quality, and between data usefulness and data accessibility. In the cases studied it was experienced that low intrinsic data quality made the usefulness of such data low (e.g. by not being able to use the data for statistics), while raising the intrinsic data quality made the data more useful. Concerning the relationship between data usefulness and accessibility, the three paths defined in the right side of Figure 2 were recognised by the interviewed, i.e. deciding to register a new type of data that later turns out not to be used, registering data sets that includes non-useful data, and increasing the usefulness of existing data by adding additional data.

CONCLUSIONS

In literature it has been pointed out that many ERP projects face problems related to inadequate data quality. To deal with this issue, this paper investigated the concept of data quality in an ERP system context. To start with, literature on data quality was investigated, and based on this the paper engaged in a discussion of which data quality categories are relevant when evaluating ERP system data. The paper argued that from an operational perspective three main categories of data quality dimensions are particularly relevant to consider in ERP projects: (1) intrinsic data quality dimensions; (2) accessibility data quality dimensions; and (3) data usefulness dimensions. Of these categories, the paper argued that for evaluation of ERP data, intrinsic and accessibility data quality dimensions are the most important, since these are the easiest to measure and cannot, as useless data, be ignored in daily operations. Thus, a 2-by-2 matrix with these categories of dimensions was defined, each axis divided into 'unsatisfactory' and 'satisfactory' states. Additionally, the paper presented the two matrices of the remaining two combinations of data quality categories, i.e. data usefulness in relation to intrinsic data quality and data accessibility respectively. By using the matrices, the paper described the typical patterns that are likely to occur in ERP projects.

To investigate the relevancy of the proposed classification model, three ERP projects were investigated. Although the cases had been selected more or less randomly, all the three selected companies had faced great problems related to ERP data quality. In the beginning of all three ERP projects, the companies had neglected the importance of data management, for which reason they later had to use many resources on correcting data. In a general perspective, during the course of all three projects, all three companies represented a move from unsatisfactory levels of data accessibility and intrinsic data quality towards being close to accomplishing satisfactory levels, although none of the three companies at the time of the investigation could be said to have achieved satisfactory levels in both categories of quality dimensions. With regard to the suggested causalities between data usefulness in relation to intrinsic data quality and data accessibility respectively, these were to a large extent confirmed by the case studies.

In summation, this paper has proposed a classification model for evaluating data quality in ERP projects. Besides, two types of causal relationships between data quality categories have been presented. The three case studies confirmed that the classification model is suited for describing ERP data quality and that the claimed relations between data qualities categories corresponds with practice.

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CONCEPTUALIZING WEB-BASED INFORMATION SYSTEMS QUALITY AND ITS IMPACT ON CUSTOMER SATISFACTION: A MULTICHANNEL SERVICE PROVIDER PERSPECTIVE

Dr. Moez Bellaaj,
Assistant professor at ISAEG, Tunisia
moez_bellaaj@yahoo.fr
Miss Ines Zekri
Assistant professor at ESCS, Tunisia
ineszekri@yahoo.fr
Dr Michel Plaisent
Full professor, university of Quebec Montreal, Canada
michel.plaisent@uqam.ca
Dr Pascal Pecquet
Full professor, Université Montpellier, France
p.pecquet@free.fr

ABSTRACT

There is a general scarcity of models and frameworks for evaluating Web-based information systems quality. Traditional theories and models in the fields of the information systems (IS) and marketing can be extended to address this issue. Particularly, we believe that deeper theoretical developments are needed to study the "IS quality" in the online environment context and its impact on the customer satisfaction in a relational mutichannel exchange area. Based on the DeLone and McLean IS success model and the SERVQUAL framework, we propose a Web-based IS quality (WISQ) model. This model examines the impact of the Web-based IS quality factors (Web-based system quality, Web-based content quality, and online service quality) on the customer satisfaction. Further research into developing, validating and empirically testing the model is proposed.

Keywords: Web-based IS quality, customer satisfaction, DeLone and McLean's IS success model, SERVQUAL, relational multichannel service provider.

INTRODUCTION

In the management information systems (IS) research, IS quality was identified as one of the most important determinants of the IS success. DeLone and McLean (1992) proposed information quality and system quality as two components of the IS quality. In 2003, they added service quality as a third new component in an updated IS success model. In this model, information quality, system quality, and service quality became the drivers of the user satisfaction (as a measure of IS success). Later, DeLone and McLean (2004) applied their updated model to organize e-commerce success metrics identified in the literature and demonstrated how it can be used through two cases studies.

DeLone and McLean (1992) applied information communication theory in dividing the IS quality into system quality and information quality, but their 2003 updated model adds service quality and new paths to their original IS success model that are not encompassed by their original theory base (Ding and Straub 2007). This renders the 2003 model interesting, but not completely coherent. On the other hand, other studies in the IS field were focused on

the IS service quality only and they have applied the marketing-originated SERVQUAL instrument to studying the quality of the human service provided manually by the IS department. "Unfortunately, and ironically, many service functions have been automated via sophisticated information technologies, and, in spite of this development, studies of IS service have tended to ignore ITs that are rapidly becoming an embedded characteristic of service. Overall, these problems saddle DeLone and McLean 2003 IS success model with an essentially manual view of IS service" (Ding and Straub 2007, p.1).

Although traditional IS success model can be extended to investigating e-commerce success, they need further refinements to meet the specificities of the Web-based information systems. The DeLone and McLean work (1992; 2003) helps researches in understanding different aspects of IS quality and success, but we think that it needs further development and validation before it could serve as a basis for the selection of appropriate Web-based IS success measures. Particularly, we believe that deeper theoretical developments are needed to re-examine the IS quality concept in the online environment context as well as its impact on customer satisfaction in the relational mutichannel exchange area.

In fact, there are several raisons which motivated the refinement of the DeLone and McLean's 2003 model to adopt it to the Web-based IS in the multichannel service provider context. First, DeLone and McLean suggested that their updated IS success model can be adapted to the measurement challenges of the new e-commerce world. They defined e-commerce as the use of the Internet to facilitate, execute, and process transactions which involve a buyer and seller, and the exchange of goods or services for money. However, this definition is too narrow in comparison with the notion of Web-based IS because it focuses on online shopping only. In fact, Web-based Information system is larger than the use of the Internet and it goes beyond the fulfilment of the electronic transactions. The Web-based information system can be defined as a dynamic and distributed platform for interactive World Wide Web application solutions in order to perform several business functions (information provision, communication, distribution, and customer service).

Second, DeLone and McLean's e-commerce definition is inserted in a transactional perspective rather than relational perspective. Transactional perspective considers that customers and service providers engaging in existing exchange do not expect future exchange. On the other hand, relational perspective is based on intensive coordination, mutual commitment and anticipatory of future ongoing interactions between customers and service providers (Ding and Straub 2007). Understanding relationship marketing requires distinguishing between the discrete transaction and relational exchange (Morgan and Hunt 1994). Discrete transaction has a distinct beginning, short duration, and sharp ending by performance. Relational exchange traces to previous agreements and is longer in duration, reflecting an ongoing process (Dwyer, Schurr, and Oh 1987). In the services marketing area, Berry (1983) states that relationship marketing is attracting, maintaining, and enhancing customer relationships. Berry and Parasuraman (1991) consider that relationship marketing concerns attracting, developing, and retaining customer relationships. In this sense, the transactional perspective privileged by DeLone and McLean (2004) is not suitable for the service provider perspective which is based on long term exchanges between firms and ultimate customers, as particularly recommended in the services marketing area (Montoya-Weiss et al. 2003).

Finally, DeLone and McLean (2004) defined service quality as the overall support delivered by the service provider, applies regardless of whether the support is delivered by the IS department or a new organizational unit or is outsourced to an Internet service provider. In this case, the IS service quality, as a component of the overall IS quality, focuses mainly on human-delivered service. However, this viewpoint needs to be adjusted to recognize the new reality of service businesses today, businesses that are either reengineered or thoroughly automated through the application of sophisticated IT such as Web-based technologies (Ding and Straub 2007; Molla and Licker 2001).

In this study, we take into account these lacunas in the refinement of the updated DeLone and McLean Model to assess to Web-based information systems quality. To avoid ambiguity, we define Web-based IS quality (WISQ) as the degree to which Web-based information system is able to provide value to customers and to effectively and efficiently fulfil their needs as well as to offer them supports in the online self-service manner. Looking at this definition, two things become apparent. First, we emphasize the pure self-service character of Web-based IS which refer to technologies-based self-service. Thus, our approach avoids the conceptual overlaps inherent in many previous IS studies, which mix up online service factors with people-based service elements.

Second, this definition goes beyond the online shopping and the use of the Internet to execute transactions (e-commerce). In effect, we focus on Web-based IS which enable customers to accomplish several activities (search information, ask questions, take requests, obtain sophisticated solutions to problems) and to interact extensively with the service provider via a Web interface in order to retrieve desired benefits. Therefore, we adopt the relational perspective characterised by a high degree of communication and interaction between service providers and customers.

In a multichannel environment context, service providers may reach customers using a mix of channel formats (online and offline) and their objective is to distribute resources across the channel mix to satisfy customers (Montoya-Weiss et al. 2003). Cross-channel synergies are particularly important in relational exchange contexts in which customers choose from different channel formats that belong to the same firm. Therefore understanding what drives customer online satisfaction is an important step in creating complementarity between online channel and offline channel for the service provider.

In this study, we examine the relationships between Web-based IS quality and the customer satisfaction in a relational multichannel context. Using the IS success models and theoretical developments in relationship marketing, we developed WISQ model. This model examines the impact of three Web-based IS quality factors (Web-based system quality, Web-based content quality, and online service quality) on online customer satisfaction which, in turn, affect the overall satisfaction.

This paper is organised as follows. First, we develop the theoretical background of the IS success model. After that, we discuss the use of it in the online environment context. Next, based on these section, we present our Web-based IS quality model. Finally, we present the conclusion and future research directions in the end of the paper.

INFORMATION SYSTEMS SUCCESS MODELS

To organize diverse research, as well as to present a more integrated view of the concept of IS success, DeLone and McLean (1992) introduced a multidimensional model of IS success. Based on the classic communication theory (Shannon and Weaver 1949; Mason 1978) as well as conceptual and empirical research in management information systems (MIS) during the period 1981-1987, they categorized IS success into six major dimensions: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. These dimensions (or many aspects of IS success) are drawn together into a descriptive model (figure 1). According to this model, system quality and information quality singularly and jointly affect both use and user satisfaction. In addition, the amount of use can have a positive or negative effect on the degree of user satisfaction and vice versa. Use and user satisfaction are direct antecedents of individual Impact which should eventually have some organizational impact.

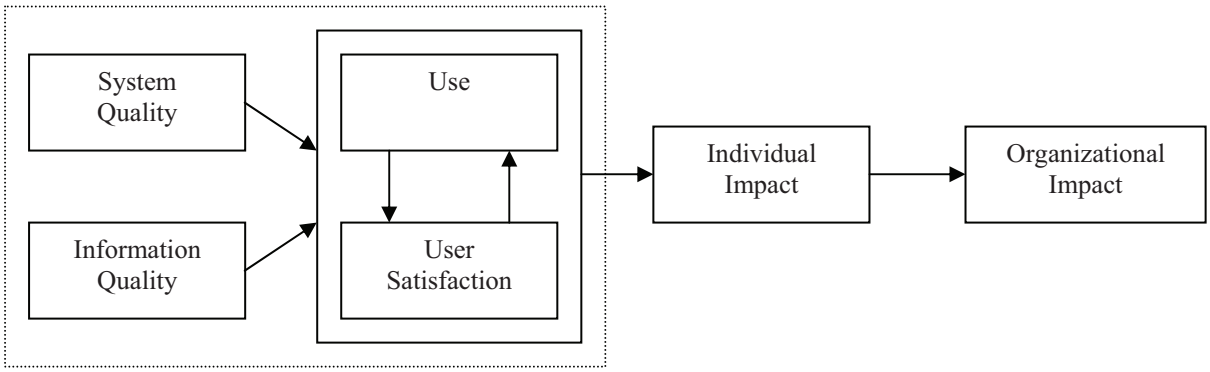

Figure 1: DeLone and McLean's 1992 Model of IS Success

The six dimensions of the IS success model are examined at three different levels: technical level (system quality), semantic level (information quality), and effectiveness or influence level (use, user satisfaction, individual impact, and organizational impact). It is possible to look into the DeLone and McLean model from two angles: the left hand and right hand sides of the model.

The left hand side of the model establishes the relationships among system quality, information quality, use, and user satisfaction. Some researchers (e.g. Livari 2005; Seddon and Kiew 1996) have produced empirical evidence to support these relationships. Furthermore, the left hand side of the DeLone and McLean model identifies the antecedents of the two most widely used IS success's criteria (use and user satisfaction). In addition, it identifies the factors that affect user satisfaction that are system quality and information quality.

Livari (2005) tested the model of information system success proposed by DeLone and McLean using a field study of mandatory information system. The results of his study showed that perceived system quality and perceived information quality are significant predictors of user satisfaction with the system, but not of system use.

The right-hand side of the model assumes linear causality between user satisfaction, individual impact, and organizational impact. However, organizational and technological

discontinuities and the existence of exogenous factors operating between the different levels militate against such linearity assumptions (Molla and Licker 2001). In this sense, a system which is successful by user satisfaction measures may not necessarily produce positive individual impact or positive organizational outcomes. The criticisms addressed to DeLone and McLean' IS success model include mixing variance and process models in one package, and the unreality of unidirectional relationship among use, user satisfaction, individual impact and organizational impact (Seddon 1997).

For the reasons listed above, we are focused on the left hand side only, and particularly on the antecedents of user satisfaction. These antecedents are system quality and information quality. They represent the two IS quality components in the original DeLone and McLean model. System quality represents the success at the technical level. It focuses on the desired characteristics of the information system itself which produces the information. Multiples measures (ease of use, usefulness of system, flexibility of system, system reliability, etc.) of the information processing system itself are reported by DeLone and McLean (1992) reflecting the engineering-oriented performance characteristics of the systems in question.

In this study, we are interested in ease of use and usefulness as two relevant measures of system quality. Theses criteria were identified as the two most widely used determinants of information systems use and user satisfaction. This will be developed with more details later. On the other hand, information quality represents the success at the semantic level. It focuses on the quality of the information system output. It reflects the desired characteristics of the information that the system produces, primarily in the form of reports. Several measures are given by DeLone and McLean (1992) such as accuracy, relevance, completeness, and timeliness.

In 1995, Pitt, Watson and Kavan presented an augmented IS success model which was adapted from DeLone and McLean (1992). Pitt et al. (1995) added service quality as a new dimension to the DeLone and McLean original model. SERVQUAL, an instrument developed by the marketing researchers, is proposed as a possible measure of IS service quality. After examination of content validity, reliability, convergent validity, and discriminant validity, the authors concluded that SERVQUAL is an appropriate instrument for the measure of IS service quality.

Later, DeLone and McLean proposed an updated IS success model in 2003. The updated model is based on the empirical and theoretical contributions of researchers who have tested or discussed the original model. The primary improvements to the original model include the addition of service quality to reflect the importance of service and support in successful IS. While system quality focuses on the desired characteristics of the system and information quality on the desired characteristics of the information, service quality focuses on the desired characteristics of service delivered by the system. The antecedents of user satisfaction in the model of DeLone and McLean (2003) are consequently Information quality, system quality, and service quality. These dimensions represent the IS quality components in the updated DeLone and McLean model (figure 2).

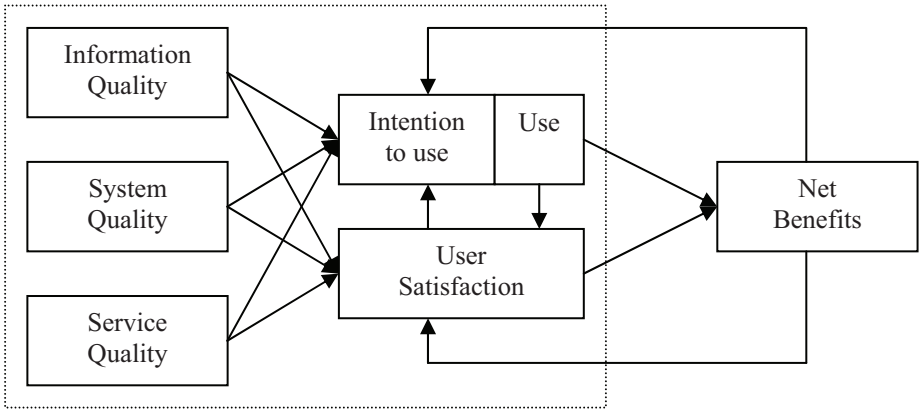

Figure 2: DeLone and McLean's 2003 Updated Model of IS Success

UTILIZATION OF THE IS SUCCESS MODELS IN THE ONLINE ENVIRONMENT CONTEXT

The dominant view of IS service in the extant IS research focuses on human-delivered service (Ding and Straub 2007). In this case, the human agent plays a significant role in the IS department considered as an organization subunit that provides direct end-users support services (e.g.: training, documentation, and maintenance) for satisfying users IS needs. This viewpoint needs to be revisited to be aware of the new reality of service businesses which are either reengineered or automated through the application of sophisticated information systems (Ding and Straub 2007). One well-known example is Web-based information systems that provide customer with direct service. In the online environment, the primary Web-based IS users are customers or suppliers rather than internal users. Web-based information system is not a simple Web presence. It allows users to achieve several works automatically without the intervention of the human agent. It enables users to search information, ask questions, and take requests. It can also provide sophisticated solutions to customer problems. Web-based IS revolutionized the way organizations provide information related to their services. Users can specify what information is to be presented, in what order or arrangement, using which colors and so on (Molla and Licker 2001). Thus, Web-based information system is a dynamic and distributed platform for interactive World Wide Web application solutions in order to perform several business functions such as information provision, communication, distribution, and customer service. It facilitates intra-and inter-firm processes, systems integration, and enables doing business electronically (Tan, Xie, and Li 2003).

The most common use of web-based IS is to enhance existing traditional channel by a new online channel. Today, many self service web-based technologies that do not call for the direct involvement of human service agent are being used by service organizations (e.g.,

online travel services, online banking services, online package tracking services, etc.). In those cases, the web-based Information systems serve as the central medium of exchange between a service provider and its customers and significantly reduce the interpersonal encounter that formed the core of the most customer satisfaction (Molla and Licker 2001). Therefore, the quality of online service influences customer satisfaction with the overall service offered by the service provider. The service quality become an important dimension of the web-based information systems in the Internet environment and the researchers are required today to include service quality as a third component of the IS quality.
In fact, Molla and Licker (2001) suggested that the original DeLone and McLean IS success model could be extended to measure e-commerce systems success. They proposed a partial extension and respecification of the DeLone and McLean's 1992 model to e-commerce systems. The system quality and information quality components of the IS quality are replaced by e-commerce system and content quality. Molla and Licker (2001) argued that these two dimensions require additional constructs that are not captured by the traditional system quality and information quality measurements. In addition user satisfaction is replaced by customer e-commerce satisfaction as a dependent variable to e-commerce success. Also, trust and service are added as new antecedents of the customer satisfaction.

Based on the Molla and Licker's e-commerce success model and as well as the IS success model which was revisited in 2002 and extended in 2003, DeLone and McLean (2004) proposed to measure e-commerce success. They applied their updated model to organize the e-commerce success metrics identified in the literature and demonstrated how this model can be used through two case examples. They defined e-commerce as the use of the Internet to facilitate, execute, and process business transactions.

DeLone and McLean (2004) identified three aspects of the IS quality in the Internet environment: system quality, content quality, and service quality. System quality reflects the desired characteristics of a Web-based information system. They considered that when the users are customers, their use is typically volitional, and this means that poor ease of use and usefulness of the Web-based IS functions (as a relevant measures of system quality) can affect negatively customer usage and satisfaction. In addition, DeLone and McLean (2004) argued that new measures of the content-quality dimension are needed because of the mass customization development occurring in the Internet environment. They considered that content quality refers to the desired characteristics and presentation of information in the Web-based information system. Finally, they introduced service quality which represents the overall value and support delivered by the service provider. In this sense service quality can be measured by the effectiveness of online support capabilities (DeLone and McLean 2004).

Based on marketing exchange theory and the DeLone and McLean's 2003 model, Ding and Straub (2007) proposed alternative nomological linkages among the three IS quality components as well as new paths depicting their impact on user satisfaction. They investigated the theoretical interrelationships among information quality, system quality, and service quality. Ding and Straub (2007) argued that, with sophisticated Word Wide Web based application solutions, the conceptual separation of systems from service needs to change. These technological applications not only assist human agent in serving customers, but they can replace them entirely.

Ding and Straub (2007) applied marketing exchange perspective to examine IS service related concepts and scenarios for developing their information system quality model (figure

3). In this model, the service quality mediates the relationship between system quality and user satisfaction on one hand, and the relationship between information quality and user satisfaction on the other hand in a positive direction.

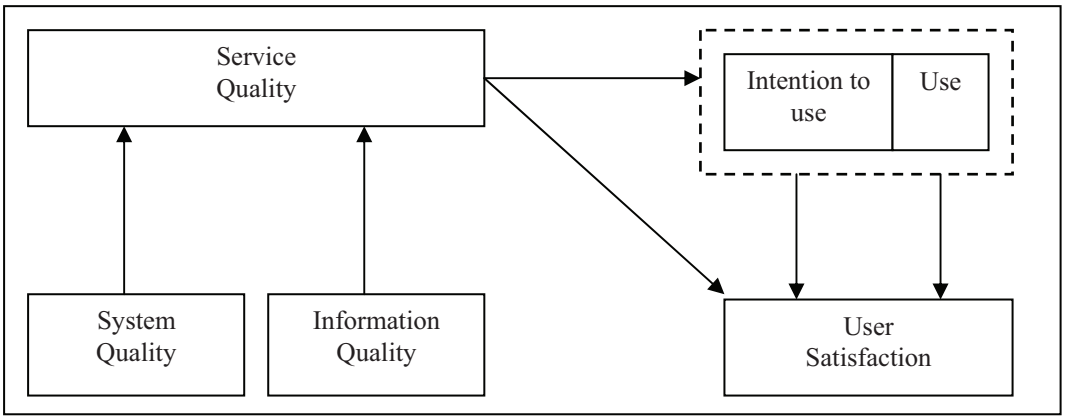

Figure 3: Ding and Straub'2007 IS Quality Model

WEB-BASED INFORMATION SYSTEMS QUALITY AND CUSTOMER SATISFACTION

Based on the DeLone and McLean's 1992 IS model which has been updated in 2003 and extended to the online environment context, and also on the theoretical development in the relationship marketing domain, we developed our conceptual model of the Web-based information systems quality (WISQ) as presented in figure 4. The WISQ model presents three IS quality components: Web-based system quality (WSQ), Web-based content quality (WCQ) and online service quality (OSQ). These components have a positive direct impact on the online customer satisfaction which, in turn, has a positive impact on the overall satisfaction.

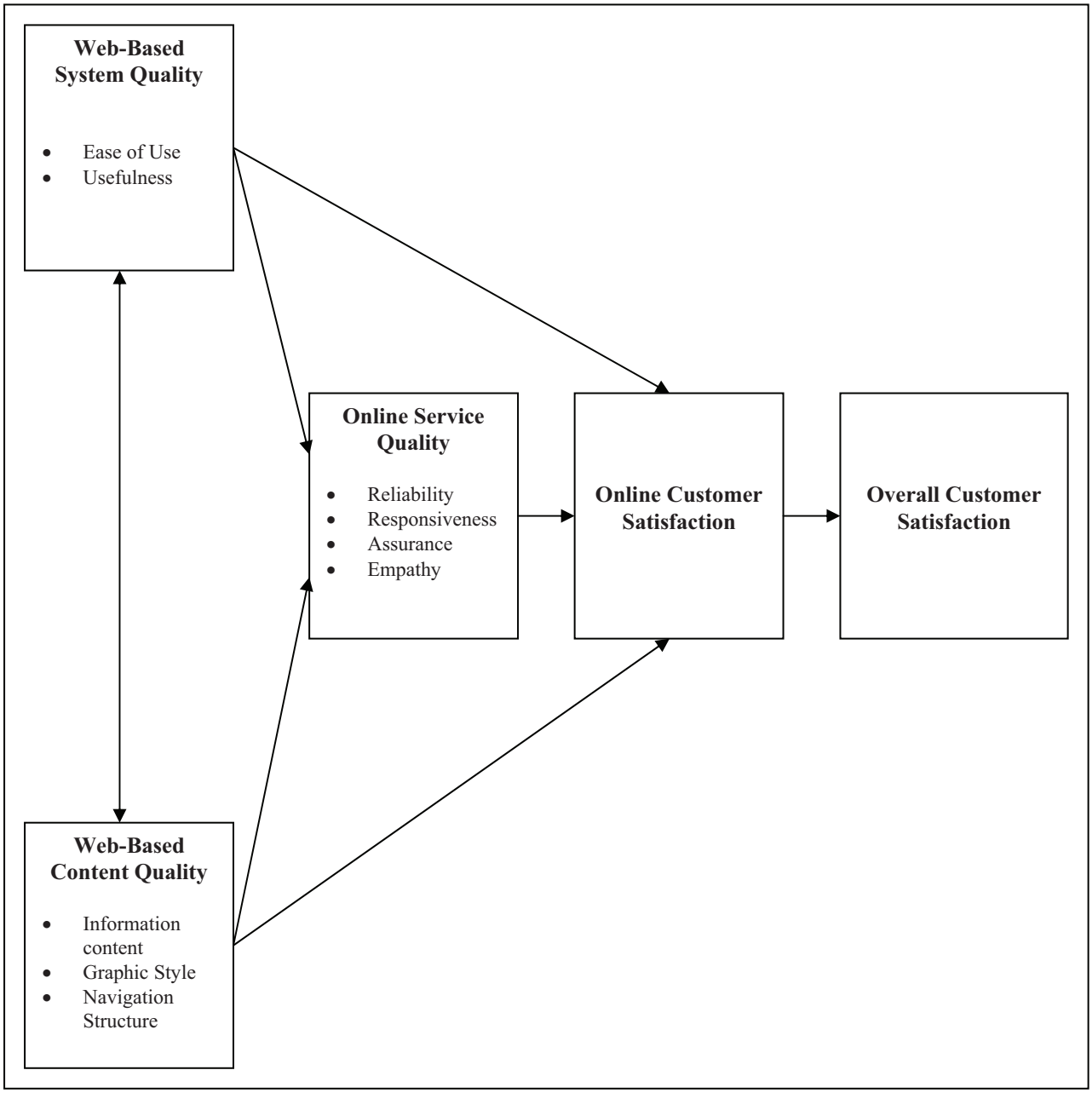

Figure 4: Web-Based IS Quality Model

Components of the Web-based IS Quality

The Web-based IS quality has three components: Web-based system quality, Web-based content quality, and online service quality which are interrelated.

The Web-based system quality refers to the desired characteristics of the Web-based IS itself and focuses on the technical capabilities of the Web site that enables favourable interactions with the customer. This component of the WISQ is closest to constructs such as perceived usefulness and perceived ease of use examined by IS researchers as a significant antecedents to various technology acceptance outcomes, and as a relevant determinants of user

satisfaction. In this study, perceived usefulness represents the degree to which a customer believes that using the Web-based information system would enhance his job performance. A system high in perceived usefulness, is one for which a user (customer) believes in the existence of a positive use-performance relationship (Davis 1989). On the other hand, perceived ease of use refers to the degree to which a customer believes that using a Web-based information system would be free of effort. An application perceived to be easier to use than another is more likely to be accepted by users (Davis 1989). Several findings suggest that, in some cases, customer satisfaction in the online environment is significantly higher than in traditional channel due the ease of use and usefulness of the Web-based IS. For example, Devraraj et al. (2002) found that perceived usefulness and ease of use are key determinants of consumers' attitude, assessed by their satisfaction with the online channel. Their findings support also that satisfaction with the online channel (electronic commerce channel) leads to customer channel preference. Devraraj et al. (2002) concluded that success criteria in IS research can be applied to online environment. They mentioned that TAM (technology acceptance model) components ease of use and usefulness are important factors in determining online satisfaction and preference channel.

Therefore, we propose to conceptualize Web-based system quality (WSQ) as a second order construct with two first-order constructs: perceived usefulness and perceived ease of use. These two dimensions taken together can offer more explanation about the WSQ as a multidimensional construct. Previous research notes that a second order approach represents a theoretically strong basis for capturing complex measures which are multidimensional in nature such a Web-based system quality (e.g., McKinney, Yoon, and Zahedi 2002).

Web-based content quality (WCQ) refers to the desired characteristics and presentation of information in the Web-based information system and focuses on the customer (user) web interfaces. Our construct "content" includes the quality and variety of information, the use of text, graphics, and multimedia as well as the navigability. Therefore, this component of the WISQ includes three subdimensions: Web site information content, graphic style, and navigation structure. In this sense, Web-based content quality is a second order construct with three first-order constructs. This conceptualization of WCQ as a multidimensional construct is consistent with previous studies in information systems research (Agarwal and Venkatesh 2002; Palmer 2002). In effect, web site information content refers to the quality of informational material that appears on the Web site. Based on prior research on the dimensionality of information, Montoya-Weiss, Voss, and Grewal (2003) suggested that three broad characteristics can describe the quality of information content in an online context: information utility (the extent to which content is perceived as useful); information accuracy (the perceived correctness or integrity of the content); and information timeless (the degree to which the content is perceived as fresh and up-to-date). By referring to Montoya-Weiss et al. (2003), we define graphic style as the tangible aspect of the Web-based information system that reflects the "look and feel" or perceived attractiveness of a Web site. Montoya-Weiss et al. (2003) conceptualized graphic style as the virtual equivalent of traditional retail store atmospherics. Graphic style reflects web site design and the appropriate use of multimedia content (Agarwal and Venkatesh 2002; Palmer 2002). Navigation structure refers to "the organization and hierarchical layout of the content and pages in a Web site" (Montoya-Weiss et al. 2003, p. 449). Palmer (2002, p. 155) defined navigability as the sequencing of pages, well organized layout, and consistency of navigation protocols. This characteristic governs a user's forward, backward, and lateral movement through a Web site and evaluates the links to the needed information (Montoya-Weiss et al. 2003; McKinney et

al. 2002). Several researches supported that Web-based content quality (WCQ) is a significant antecedent of the online customer satisfaction. For example, Palmer (2002) found that user satisfaction (as a measure of the Web site success) is significantly associated with the navigation (organization, arrangement, layout, and sequencing) and content (amount and variety of information). Also, McKinney et al. (2002) verified the positive impact of information content and system design on the Web-customer satisfaction.

The third component of the WISQ is the online service quality (OSQ) which refers to the overall value and support delivered by the service provider online via the Web-based IS. SERVQUAL, a widely used instrument in marketing research to measure customers' expectation and perception of service (Parasuraman et al. 1985), was adapted to measure IS service quality (e.g. Pitt, Watson, and Kavan 1995, 1998; Jiang, Klein, and Crampton 2000; Jiang, Klein, and Carr 2002). In the Internet context, SERVQUAL instrument has been applied also to assess the factors associated with Web site success (e.g., Liu and Arnett 2000) and online channel satisfaction (e.g., Deveraj et al. 2002; Zhu et al. 2002). For instance, Liu and Arnett (2000) measured service quality as quick responsiveness, assurance, empathy, and following-up service. In another study, Deveraj et al. (2002) utilized the SERVQUAL items in a single survey to operationalize consumers' perceived service quality through reliability, responsiveness, empathy and assurance of the online channel. In this study, we retain these four dimensions to assess the online service quality. The tangible dimension of SERVQUAL instrument is not included for the lack of significance of this dimension in previous study (e.g. Jiang, Klein, and Crampton 2000; Jiang, Klein, and Carr 2002). Reliability refers to the ability of Web-based IS to perform the promised service dependably and accurately. Responsiveness refers to the willingness of web-based IS to help customers and provide prompt service. Assurance reflects the ability of Web-based IS to inspire trust and confidence. Empathy represents the ability of Web-based IS to provide caring and individualized attention to customer. Consequently, online service quality (OSQ) is conceptualized as a second order construct with the previous dimensions as four first order constructs. Other authors adopted the same hierarchical service quality approach for electronic services, which includes several dimensions and subdimensions (Fassnacht and Koese 2006; Parasuraman, Zeithaml, and Malhotra 2005).

Web-Based IS Quality and Customer Satisfaction Relationship

Satisfaction refers to an ex post evaluation of consumers' experience with the service and is captured as a positive feeling, indifference, or a negative feeling (Anderson 1973). In the service-related industries which mobilize sophisticated customer-oriented Web-based IS, it's difficult to differentiate the experience with the service delivered itself and the experience with the system used to deliver the service. For providers in many service industries (e.g. insurance, professional services, banking, travel) the service delivered is highly intertwined with the system (Ding and Straub 2007; Molla and Licker 2001). Therefore, the customer's satisfaction reflects both his experience with the service and with the system which distributes it.

In multichannel service providers' context, we differentiate online customer satisfaction and the overall customer satisfaction. We define the online customer satisfaction as the evaluation of an emotional reaction or feeling of a customer in relation to his/her experience with all aspects of a Web-based information system. On the other hand, we define overall satisfaction

as an ex post evaluation of customers' experience with the overall service delivered (online and offline) which is captured by a positive feeling, indifference, or a negative feeling.

Defined in such way, customer online satisfaction can serve as a dependant variable which is affected by the three components of the Web-based IS quality: Web-based system quality, Web-based content quality, and online service quality. In addition, the overall satisfaction is, in turn, affected by the online satisfaction. In a relational, multichannel context, customers can have experience with multiple channels which have both competitive and complementary effects. Competitive effect is present when higher perceived service quality of one channel over another will lead to channel preference, and complementary effect occurs when higher perceived service quality of all channels will lead to higher overall customer satisfaction (Montoya-Weiss et al. 2003). When Web-based information system is perceived to offer high service quality in complementary manner with traditional channel, we expect that the online customer satisfaction will be higher, and consequently the overall satisfaction with service provider will be greater.

In our conceptual model (figure 4) the three components of Web-based IS quality (WSQ, WCQ, and OSQ) affect directly customer online satisfaction which contributes to the overall customer satisfaction. The relationship between Web-based IS quality and customer satisfaction is based on the previous IS success models (e.g., DeLone and McLean 1992, 2003), but the link between online satisfaction and overall satisfaction is new and is inspired by the theoretical developments in marketing and IS research in the Internet context (e.g., Montoya-Weiss et al. 2003; Devaraj et al. 2002).

In addition, because of our focus on the service context, we position online service quality (OSQ) as the central mediating factor in our model. Modelling service quality as mediator is consistent with prior research in marketing that has shown service quality perceptions are important drivers of customer's satisfaction (e.g., Fassnacht and Koese 2006; Parasuraman et al. 2005; Zeithaml et al. 2002). In their empirical study, Montoya-Weiss et al. (2003) demonstrated that, in the relational multichannel environment, online channel service quality mediated the relationship between the Web-based content quality (information content, navigation, and graphic style) and the overall satisfaction with the service provider. Modelling service quality as mediator is consistent also with recent research in the field of IS. For example, Ding and Straub (2007) note that the overwhelming proportion of service delivery will be carried out through systems rather than human agents and the provider will render service to its customer primarily through many self service Internet-based technologies. In their alternative IS quality model, Ding and Straub (2007) state that service quality mediates the relationship between IS quality (information quality and system quality) and user satisfaction.

Finally, in our conceptualization of the Web-based IS quality, we consider that Web-based system quality and Web-based content quality can interact together, and the one can influence the other. The reciprocal effect is due to the complementarity between these two Web-based IS quality components which are evaluated at the technical level. The technical capabilities of the Web site that enable favourable interactions with the customer (WSQ) can influence the characteristics and presentation of information in the user web interfaces (WCQ), and vice-versa.

SUMMARY

While a Web-based IS can be considered as a Kind of information systems, thus providing the justification for the application of IS theories, their specific characteristics in terms of connectivity, interactivity, and open-standard network integration distinguish them from pre-Internet information systems (Zhu and Kraemer 2005; Zhu and Kraemer 2002). Therefore, any effort to extend IS success models and measures to the online environment context needs to consider the unique characteristics of the Internet. On the other hand, the similarities between Web-based IS and the traditional IS motivate and extending original models such as IS success models to Internet domain (Molla and Licker 2001). Through theoretical discussions of how system quality, information quality, and service quality are related to each other and to user satisfaction, this research applies and extends a part of DeLone and McLean'2003 IS success model to the Internet environment by developing a Web-based IS quality (WISQ) model. Thus, using the IS success models, as well as the SERVQUAL framework, we conceptualized the WISQ and its impacts on online customer satisfaction, and overall satisfaction in the multichannel service provider context. Further research is required to improve both the theoretical base and operational constructs of the WISQ and develop reliable and valid measurement instruments. Future empirical studies will examine also how the Web-based IS quality factors are related to each other and how they affect downstream construct such as customer satisfaction. The implications of the research should help service providers see better how Web-based IS quality can affect positively the online customer satisfaction which, in turn, can influence positively the overall customer satisfaction in a relational multichannel area.

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INTEGRATION OF INFORMATION TECHNOLOGY INTO THE BUSINESS MODELS OF HEALTHCARE SYSTEM

Yung-Chieh Chien, National Sun Yat-sen University, Taiwan
jsnchn@ms9.hinet.net
Pei-Shun Ho, Avectec.com, Inc, Taiwan
jason@avectec.com.tw
Ben-Jeng Wang, HungKuang University, Taiwan
bjwang@thu.edu.tw
Ching-Rei Kuo, National Sun Yat-sen University, Taiwan
chinrei.kuo@msa.hinet.net

ABSTRACT

As fewer and fewer children are born each year, not only family structure has changed, the proportions of elderly persons in many countries also have increased significantly. Consequently, home healthcare services for the elderly have become a new and promising business. The objective of this project is to integrate information technology into the business models of healthcare system. The first year's goal is to design a business model of home healthcare system by evaluating the market through gathering information like the percentage of elderly population, the scale of heath care market, and the actual demands for healthcares for the elderly in the society. The goal for the second year is to integrate the information technologies such as the radio frequency identification, global positioning system, global system for mobile communications, and hospital information system to construct a business model of the healthcare system. In addition, this paper also aims to replace the current passive and manual way of searching missing patients with the help of the information technology. Further, the project plans to establish a system which provides monitoring schemes such as indoor residence monitoring, outdoor activity area monitoring, emergency rescue, and remote monitoring modes. Results of these studies should provide important insights for the development of healthcare systems integrated with information technology for the future.

Keywords: healthcare services, information technology, business models, radio frequency identification, M-business

BACKGROUND

As fewer and fewer children are born each year, combines with advancement in medical science which extends the average life span of humans, the proportion of elderly persons has increased significantly in many societies. In response to elderly's growing population, the healthcare market for the elderly has grown considerably, and definitely has become one of the promising industries. As the proportion of the elderly continues to rise, governments should plan early to meet the upcoming massive healthcare demands.

Aging population structure and its influences

Due to extended average life spans and decreasing population growth, Taiwanese population's aging speed is among the fastest in the world, only next to Japan. According to Taiwan's Council for Economic Planning and Development's (CEPD) estimate, by the year 2026, elderly population will reach 4.82 millions, a staggering proportion of 20%. And by the year 2051, elderly proportion will reach as high as 35%. CEPD expects Taiwan to enter an aging society by the year 2018. According to Industrial Technology Research Institute (ITRI) Biomedical Department, domestic medical care market will grow 440% from US$24.6 billion in 2001 to US$108.9 billion by 2025. Field experts and organizations strongly encourage that a complete healthcare system should be set up as early as possible.

Taiwan's current policies

Currently, government has provided different degrees of healthcare for the elderly in accordance with regulations stipulated by the "Senior Citizens Welfare Act". According to Enforcement Rule 7 of this Act, local authorities, if necessary, are responsible for encouraging and rewarding private enterprises for setting up various types of welfare institutions for the elderly. Therefore, current mechanism of healthcare for the elderly is guided by Senior Citizens Welfare Act. In addition, the Ministry of the Interior has enacted two ordinances: "Establishment Standards of Senior Citizens' Welfare Institution" and "Permit and Management Regulations for the Establishment of Private Senior Citizens' Welfare Institutions" which give specific guidance for the buildings, facilities, equipments and workers of senior citizens' welfare institutions.

With the advancement in communication technology, in 2008 the government has included "Telecare" industry into the plan to develop newly service industry in 2008. By combining information technology applications, following projects are being implemented:

1. Department of Health: Telemedical Plan, a communication plan between medical center and remote medical units.
2. Department of Health: National health insurance family doctor integrative nursing care system plan.
3. Legislative Yuan: Long term nursing care pilot plan. The purpose is to build a strategic blueprint to guide future healthcare system.
4. Department of Health: build and maintain a long term caring information plan which covers the entire healthcare system to provide long term care for long term disabled persons, until they have improved or recovered certain functions.
5. Ministry of Economics: Integration of caring service information system application research. Establish a comprehensive hearth care service industry alliance and build a system which can provide professional health and nursing care even when patients are at home.
6. Ministry of Economics: Telemedical plan. Combining various fields like preventive medical science, information communication, and emergency medical service to allow people who require caring can send physical data through GPRS or ADSL broadband to information center.
7. Ministry of Economics: U-care flagship plan. Assist institutions in community care,

home care, and emergency care for the elderly.

8. Legislative Yuan: 3 phase plan between now to 2015. In the first phase (2007-2009), the central government speeds up the healthcare development policy by declaring healthcare industry as one of the promising industries in the future.

Relevant measures taken by other countries

Currently, many countries have applied information and communication technologies to increase the quality of healthcare system. More specifically, relevant applications are:

1. MobiHealth plan by European Union
   Combining wireless communication technology with Body Area Network (BAN) which automatically transmits patients' bio-signals from sensors attached to their bodies.
2. IdeaTel plan by New York State
   Through information equipment which allows patients to check various diabetes figures and receives test results at home.
3. Tele-homecare System by Japan
   Panasonic Company has designed a series of equipment specifically for patients with chronic illnesses and can be used at patients' own homes. Patients can have direct video conference with medical personnel. Taking advantage of its R&D strength, Panasonic has set up Matsushita Nursing Home Company which operates its own nursing home business.

However, in order to set up a complete healthcare system, other than governmental policy support, it still requires a comprehensive healthcare mechanism like an integrative business model, to facilitate and smooth out the actual operation. Currently, public elderly welfare systems along with private elderly healthcare institutions not only are mostly regional, but their resources may overlap in certain areas. This is caused by unclear positioning of the healthcare mechanism. As for the Telecare plan which the government has been promoting but not very successful because it failed to integrate two major parts: medical resource and information technology; thus unable to provide an integrative operation flow and business model. An operable business model should incorporate RFID, Mobilized medical service, and hospital related information technologies to develop a system for elderly healthcare.

LITERATURE REVIEW

Worldwide medical industry and regulations

Economic prosperity has brought about major scientific growth in the medical industry. In most advance countries, healthcare service sector accounts for about 6% of their GDP. According to a WHO publication, providing medical services internationally has become ever more important. Particularly, U.S. vendors have been providing commercial distant medical services to several countries in the Middle East. For example, the country Jordan has set up distant medical service network with Mayo hospital of the U.S. Similarly, China, Taiwan, Macau, and other Southeast Asian countries have set up distant diagnosis services.

However, health and social service industries usually are banned from providing cross country services. One of the reasons is to ensure medical safety. Most countries have restrictions in areas such as medical service providers (doctors, therapists, nurses, and etc.,), companies, institutions,

and organizations in the medical system (clinics, hospitals, and nursing homes), and other business entities (equipments and medicine suppliers and insurance companies). This is a very common situation in most countries. Therefore, the most a medical firm can do as to providing cross country service has narrowed down to simply providing tangible products and insurance service. As for the intangible professional medical judgments, cares, and institution operation know how, it has been a common understandings that all international firms must follow strict local regulations. The following is a table of various governing laws of England, Germany, Japan, and Taiwan..

Table 1. Comparison of healthcare laws between different countries

	England	Germany	Japan	Taiwan
1. legal structure				
Legal name	● National Health Service and Community Care Act	● Soziale Pflegeversicherung ● Bundes-soziahilfegesetz	• Various Insurance laws (nursing & elderly welfare) • Elderly Welfare Act • Physically handicapped Welfare Act • Mentally Retarded Welfare Act • Mentally Handicapped Welfare Act	• Senior Citizen Welfare Act • Physically and Mentally Disabled Citizens Protection Act • Mental Health Law • Clinical Nurse Law
Supervising authority	● Department of Health ● Local Authority (Director of Adult Social Services DASS)	● Federal Department of Health ● Federal Long Term Nursing Care Commission ● Local Authority	● Ministry of Health, Labor, and Welfare: policy making ● City authority：policy execution	●Department of Interior ●Local Authority
2. applicable subjects				
Age	Citizens age 16 and above or handicapped	Citizens	Citizens age 40 and above or handicapped	Citizens age 65 and above or handicapped
Asset Check	• (health service：x • community care)	• Nursing insurance payment：x • Social Welfare payment：x	• Nursing insurance payment：x • Welfare Benefits	Welfare benefit：(depends on asset evaluation)

3. Demand Evaluation				
Evaluating Institution	All health and social needs must be evaluated by a committee authorized by the local authorities before services can be provided. Committee members include doctors, nurses, therapist, social workers, and other professional personnel.	Follow medical insurance service procedures ((nursing insurance law 18)	The city authority designates a nursing home to do the evaluation first, than a committee (members are experts of various fields in the industry) will make the final nursing decision.	Local authority's long term nursing care management center
Demand Level	4 levels： 1. critical 2. Substantial 3. Moderate 4. low	3 levels： 1. first level: needs nursing care at least once per day 2. second level: needs nursing care at least 3 times per day 3. third level: needs nursing care all day	Nursing is classified into six levels： 1. Level 1 2. Level 2 3. Level 3 4. Level 4 5. Level 5 6. Need support	
4. Service Mode and Content				
Mode	1. at home 2. institution 3. communit y	1. at home 2. institution	1. at home 2. institution	1. at home 2. institution 3. community

Medical and nursing care scope of Taiwan

According to a report by CEPD, Taiwan has entered an aging society in year 1993, and is expected to enter into an aged society in year 2018. The demand for healthcare has continued to increase as a result. However, according to a government industrial classification table, medical nursing care is not even a category. However, CEPD has classified the medical care institutions into several categories; from emergent to chronic, technical to non-technical long term care

services (see chart 1).

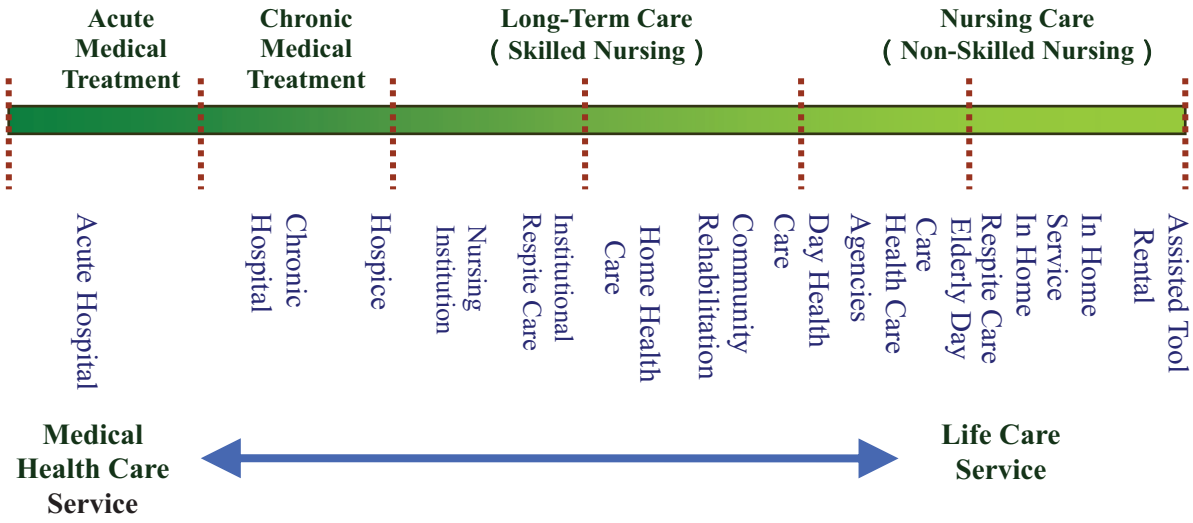


Chart 1. Medical Health Care Classification

Source：Legislative Yuan CEPD (2004)

Current medical care situation of the elderly

There are five major providers of long term nursing care services: (Yu-Mei Ruan et al. 2001):

(1) Home based care：Family members or relatives are responsible for the care. This is the major source of care labor in Taiwan.

(2) Unofficial community care：Unofficial means unlicensed nursing care institutions in a community. It provides major 24hrs accommodations in Taiwan.

(3) Veteran system from the military

(4) Social welfare system

(5) Medical service system

According to Senior Citizens' Welfare Act, domestic nursing care institutions, depending on the level of care required, can be classified into 3 major categories:

(1) Nursing home: Mostly medical, partly social functions.

(2) Nursing care institution: Mostly maintain residents' health, partly social functions.

(3) Care institution: Mostly social, partly maintaining residents' health functions.

The last two categories are often mixed under one institution, which is normally called "nursing care institution". (Hsio Chin Shen, et at. 2003). Taiwan's welfare policy for the elderly covers a wide range of areas, including their life and health, psychological and social needs. However, government resources are divided and the applicable regulations are not uniform. A systematic integration of resources and laws is yet to be developed.

In the last decade, the government has spent much effort on consolidating various governing

agencies of social and medical welfares, but the result has been disappointing. For example, though the standards of setting up nursing homes and elderly long term care institutions are the same, but due to different governing authorities, only one type of business thus one kind of subsidy can be applied. (Tsen Yung Wang, 2000). On the other hand, in terms of human resources, nurses are the major source of labor in nursing institutions, but some not only are having difficulties in employing sufficient nurses, the turnover rate and quality of nurses are also far from ideal. The shortage of care assistant is even worse. (Yu Mei Ruan, 2001). Furthermore, most caregivers are not qualified in giving professional care. So in terms of home care, other than family members, foreign maids are often required to take care of the elderly part time.

Market demand of elderly's medical and nursing care

Current domestic elderly nursing care follows the principles set forth in the Senior Citizens' Welfare Act. Bordy and Masciocchi believe that in order to provide a complete and continuous long term heathcare, the system should include 3 major types of services: family, community, and institution.

Due to natural deterioration of various body functions, many elderly requires the assistance of nursing and medical equipment to sustain their lives. However, medical institutions not only need to take care of elderly's physical health, but also their psychological and social health. Many times, the feeling of respect and mental security are what elderly lacks of. Depending on their body conditions, elderly's nursing cares are divided into two parts: one is the official nursing care system, the other is an unofficial nursing care system. See chart 2 below.

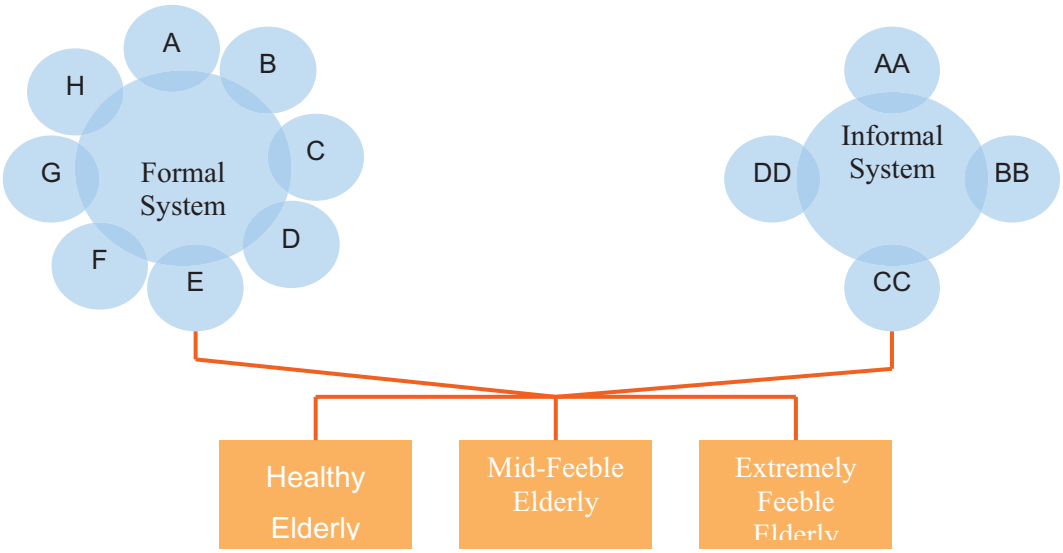


Chart 2. Elderly Care System Classification

A. entertainment B. application assistance C. meal delivery D. chores services
E. health assistant F. transportation service G. consultation service H. odd jobs
AA. emotional support BB. financial management assistance
CC. occasional meal delivery DD. Short-tem assistance

According to Industrial Technology Research Institute (ITRI) Biomedical Department, domestic medical care market will grow from US$24.6 billion in 2001 to US$108.9 billion in year 2025, a growth of 440%. The scope of this market is to provide continuous assistances to those with long term functional disability, like patients with chronic illnesses or handicapped persons, which are services necessary for them to recover or improve their impaired functions. There are 3 dimensions to this market:

(1) provide daily living care services: prepare foods, cleaning, driving, shopping, bathing, etc.,
(2) provide specialized service to reduce functional disabilities: evaluation, rehabilitation, treatment, etc.,
(3) provide environment improvements: environment evaluation and remodeling, assisted equipment, and enhance functional disability's moving ability. (Shu Chung Wu, 1999)

According to a research by Institute for Information Technology in 2005, about 72% of the families with members who were being take care of at home, believed that their members were satisfied with their current cares. And if there are areas to be satisfied, most families believe that medical health examination is what they need. 14.2% of the families consider medical examination to be most desirable, home-based nursing care is next.

Business model

According to the Department of Health's definitions, elderly's medical and nursing cares should be classified by their service locations and service intensity. Basically, they are divided into institutional-based care, community-based care, and home-based care. Among them, community-based care and home-based cares are both classified as home-based cares. (World Health Organization, 2000) In the following table, long term cares are classified according to their service types and subjects:

Table 3. Long term care services operation model

Type	Service targets	Service provided
Home-based	Elderly with low income or physically handicapped or unable to manage oneself and are not taken care of by others	• Care takers: in house service, emotional support, living care, and home based nursing • Automated equipment: provide basic medical equipment services
Institutional-Based	Elderly who need to be taken care of on a long time basis because they are critically ill or highly unindependent or without family nursing resources, or with chronic diseases	• Care taker: professional nurses provide medical services, rehabilitation services, and nursing services. • Automated equipment: use machinery to treat and help patients rehabilitate. Operation models include independently run, or run by hospitals, or by funds.
Community-based	Elderly whose family members need to work. The purpose is to share wage earners' nursing loadings so their incomes activities are not disrupted.	• Care takers：day care, regular phone calls, meal delivery, short-term or temporary nursing care, and transportation services. • Automated equipment: provide basic medical equipment services

However, institutional-based care, community-based care, and home-based care are the 3 major dimensions of healthcare and must be covered by the operation scope of a business model. In addition, medical organization is another dimension that should also be included in the picture. That way, emergent illness and other professional medical treatment can also be provided to the elderly. In the actual operations, there are 3 areas that should be included:

1. Daily living care: provide food, cleaning, transportation, shopping, bathing, toilet using, feeding, moving services.
2. Functional disability service: provide evaluation, rehabilitation, nursing, treatment services.
3. Environment improvement solution: provide solutions to increase the activeness of elderly through environment evaluation and remodeling and assisting tools (Shu Chung Wu, 1999)

RESEARCH FRAMEWORK

After studying the current market conditions of elderly's healthcare, and combine it with government policies, relevant literatures, and in-depth expert interviews, this research has developed a business model, which integrate medical and nursing care management with information technology application for elderly's care. This model's conceptual framework is as follows:

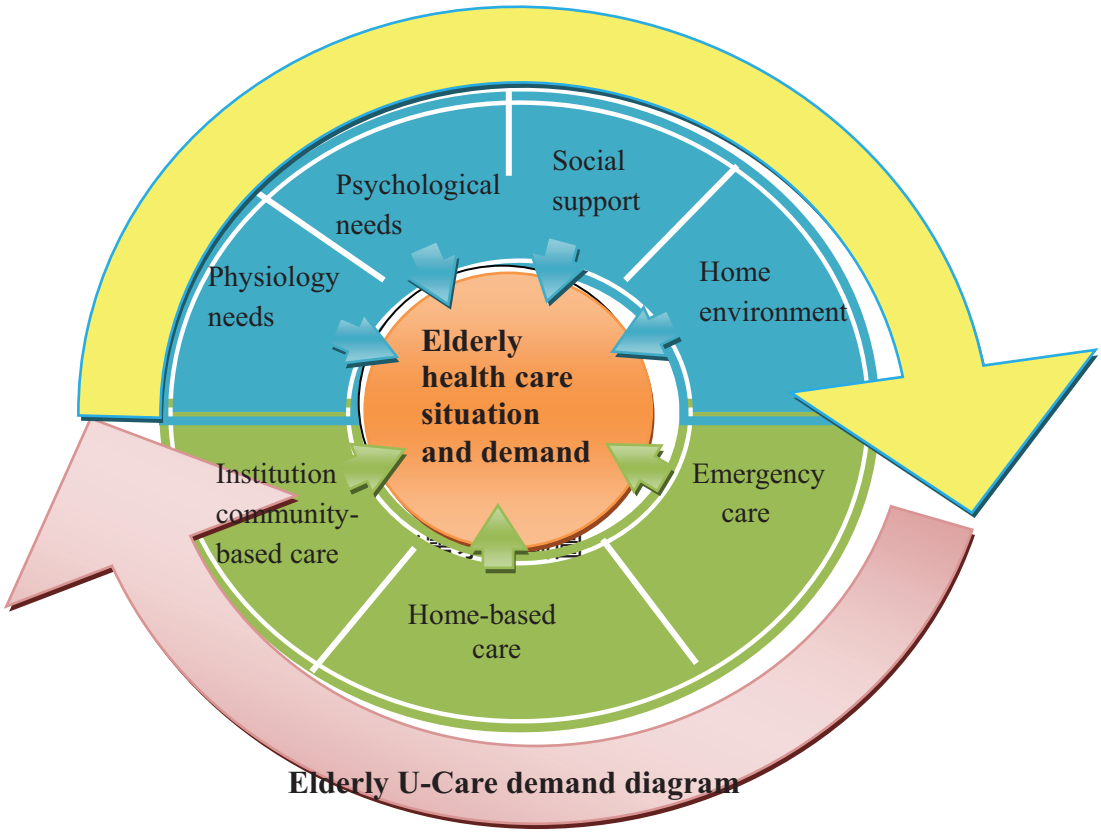
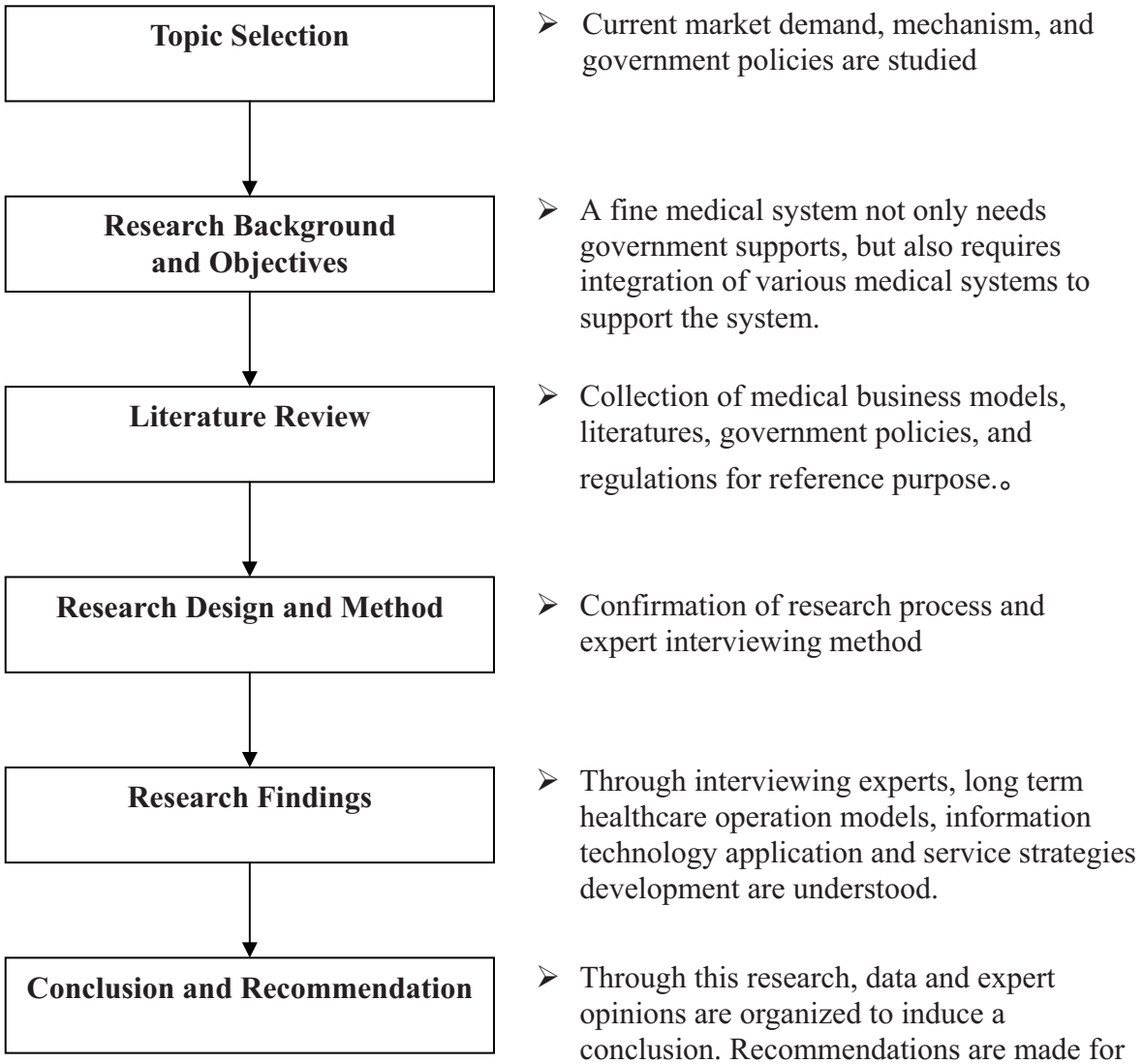


Chart 3. Elderly Care Diagram

Research Flow



Graph 5. Research Diagram

Research methodology

(1) Expert interviews
Experts who understand and have practical experiences with the long term medical and nursing care markets were interviewed. Business models, technology applications, and service strategies were extracted from the interviews.

(2) Interview's background
Two field experts were interviewed. The topics of the interview included home-based care, institution-based care, and hospital-based care. The future development of each was also discussed. From interviewing field experts, this research hopes to truly reflect the directions actual practice is moving, and provide future operation model, technology application, and strategy suggestions.

(3) Interview questions design
Through qualitative questionnaire designs, consensuses were reached among fields experts. There are 2 major parts:

- **First part:**

This portion is about how elderly's long term caring needs are affected by their physiological and psychological conditions, social support, and living environment as a basis for questionnaire evaluation design. This is to make sure that all facets concerning elderly's needs are systematically discussed.

- **Second part:**

Elderly's U-Care flagship plan which includes dimensions like institutional and community based cares, home-based care, and emergency care are the focus of this part. Elderly's demands of these three business models are individually discussed and sources of satisfaction located. Hopefully, an integrative business model can be proposed to uncover the potential of the medical and nursing industry.

CONCLUSION

Demand drives innovation. Current medical care system also has been driven by the demand to develop various long term care information system. However, many problems remain unsolved. If the problem cannot be treated objectively or seen from a broader perspective, elderly's problems will never be resolved effectively. Through in-depth interviews with field experts, this research has uncovered various weaknesses in the long term care nursing care system and would like to make the following recommendations:

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Employed full time experts to help manage the nursing care information system

Currently long term nursing care systems of the Department of the Interior and the Department of Health are not operated by full time staff. Information systems not only need specialized professionals to operate, but also need to work closely with staff on the first line. Appropriate medical information should be collected on a case by case basis to meet the requirement of the decision units. Adjustments can be made as required.

Personal feelings outweigh cold machine

Elderly who are being taken care of can be anyone's senior relatives or friends. They are humans with feelings like everyone, and need to be treated like a real person and not just a number or subject. Their feelings are more important than readings from body sensors or medical equipment, and need to be treated with sympathy. Understanding elderly's religions, interests, and hobbies and provide corresponding personalize services is also essential to their health.

Develop caring service network via new technologies

The focus of future home based care is to combine resources from medical treatment, self–care, and preventive medicine. In the future, cooperation with other supporting industries can assist home care industry to provide more versatile services. Home based nursing care should be more than just providing medical treatment, but with the help of RFID technology, elderly's physical health information can be efficiently and easily exchanged between different medical units. And in case of emergency, doctors can get a hold of patients' past body conditions immediately.

Automated inflexible management is not suitable

From interviewing elderly who needs care, this research has found that short visits by medical staff cannot really understand elderly's actual needs. Professional medical personnel should take the initiation to care and understanding elderly's real needs or interests. Professional medical opinions or regulations may not be the best way for locating and servicing elderly.

Set up emergency hot lines for community nursing care

From the interviews this research has also uncovered another deficiency: emergency connection hotlines between community nursing care institutions and the hospitals are not responsive enough, causing medical treatment delays. This paper recommends that a community should leverage its number of residents and set up a health examination station with professional staffs to regularly evaluate and store elderly's medical information. Therefore, in time of emergency, elderly can be sent to an appropriate hospital with complete medical records.

Nursing care at home meets the need of the domestic market

Most elderly would prefer home nursing care over hospital or institutional cares. From the interviews, this research has found that most elderly prefer home-based care much higher than the care given by foreign caregivers. There are two dimensions to this phenomenon. From the perspectives of the elderly's children, reasons include: 1. elderly dislike foreign maids, 2. domestic maids are easier to communicate, 3. most families are not qualified to apply for foreign maids. From the perspectives of the elderly, reasons include: 1. language barrier, 2. feel foreign caretakers are not trustworthy due to culture barrier, 3. do not like a foreigner living in the house. Due to the above, domestic care givers are always consumers' number one choice.

Application of Information Technologies on Nursing Industry

A complete long term care system needs to combine medical, information, and internet technologies. Applying information technologies on the nursing industry can satisfy administration, management, and nursing decision needs. Information technologies are being applied in many industries, including the medical profession. Currently, many advance countries are already applying information technologies on the medical industry, and slowly extend the use into the nursing care. In Taiwan, the application of information technologies is mostly on elderly's long term nursing care, security, and emergency notification services. To conclude, utilizing technologies to meet the needs of various service demands not only can greatly reduce the burdens of relevant parties, but also highly increase the quality of the entire nursing system. In other words, integrating information technologies into the industry is the main stream of the entire global medical industry trend.

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THE STRATEGIC ALIGNMENT AMONG BUSINESS STRATEGY, OPERATIONS STRATEGY, AND INFORMATION SYSTEMS STRATEGY IN ORGANIZATION

Dr. Yue-Yang Chen, I-Shou University, Taiwan
Dr. Hui-Ling Huang, Shu-Te University, Taiwan
Mr. Che-Wei Hsu, I-Shou University, Taiwan
Mr. I-Chen Tsai, I-Shou University, Taiwan
chenray60@gmail.com

ABSTRACT

The concept of strategic alignment rooted in the contingency theory tradition and refers to the match between (or among) a set for theoretical dimensions, has served as the central idea to the development of theory in many management disciplines. With the emerging of operations management area, operations activities have been strongly emphasized and treated as a strategic weapon for decades. Facing an extremely turbulent environment, manufacturers are dealing with a situation needed to be highlighted profoundly. Up to now, operations strategy has been proved that it has significant impact on organizations performance. Meanwhile, across a wide spectrum of areas, IS strategy is transcending its typical image of "supporting role" and is evolving toward a "strategic" role with the potential not only to support business strategy, but also to shape a new business strategy. Business strategy could be viewed as one of strategies top in an organization, which gives a rough picture for every unit in its organization to fulfill step by step. The general purpose of this study is to build up a conceptual model for the further research related to operations strategy strategic alignment. All in all, there are reasons to believe that each of them should fit together and have positive impact on organization's performance.

Keywords: Strategic alignment, Operations strategy, Information system strategy, Business strategy

INTRODUCTION

Research Background

The concept of strategic alignment, rooted in the contingency theory tradition, has served as the central idea to the development of theories in many management disciplines (Van de Ven, 1979). Moreover, it is well known and discussed in managerial behavior and organizational

analysis (Delery and Doty, 1996; Miles and Snow, 1984). It provides researchers with a broader view to identify the four components of strategy, namely market opportunity, corporate competences and resources, personal values and aspirations, and acknowledged obligations to segments of society other than stockholders (Andrews, 1980; Venkatraman, 1990). For contingency theorists, they believe strategy should be fixed, changed, reformed, or even canceled under different scenarios due to the dramatically changing environment. Especially, it's a huge breakthrough after Venkrataman's (1989) study suggests six methods to measure the degree of strategic alignment. Since then, researchers could explore the relationship between different strategic domains with six approaches. Consequently, although there are researchers calling for papers, little attention has been devoted to academic filed and industry.

With the emerging of operations management area, it's gradually invoking scholars' and practitioners' attentions that how to use operations activities to enhance or even maximize organization performance. Therefore, operations activities have been strongly emphasized and treated as a strategic weapon for decades (Skinner, 1969). Besides, facing an extremely turbulent environment, firms, especially manufacturers, are dealing with a situation needed to be highlighted profoundly. Hence, the priority in researchers' and practitioners' mind has been shifted to how to adopt an appropriate operations strategy instead of simply increasing productivity. Additionally, from a strategic perspective, people in this filed are looking for a way to obtain so-called "competitive advantages". Until now, operations strategy has been proved that it has significant impact on organizations performance (Skinner, 1969; Smith and Reece, 1999; Sun & Hungs, 2002).

Meanwhile, it's just similar with the development of operations strategy that information system strategy (IS strategy) has gradually drawn researchers' and practitioners' attentions. Across a wide spectrum of areas, IS strategy is transcending its typical image of "support role" and is evolving toward a "strategic" role with the potential not only to support business strategy, but also to shape a new business strategy (Henderson & Venkatraman, 1999). Practical speaking, for manufacturers, when they're conducting operations strategy or operations activities, cooperating with their information systems is one thing need to take into account(Sambamurthy & Zmud, 1999; Reich and Benbasat, 2000; Cao & Schniederjans, 2004). Therefore, the important role IS strategy plays is not only cooperating with operations strategy, but also strongly link to business strategy.

Advantages are determined, at least in part, by how effectively and efficiently the firm's business strategy is implemented (Walker and Ruekert, 1987). Thus, business strategy could be viewed as one of strategies top in an organization, which gives a rough picture for every

unit in this organization to fulfill step by step. Undoubtedly, the importance of business strategy is undeniable, because it is the direction for other functional strategies (e.g., operations strategy and IS strategy) to go forward, if they co-align well (Sambamurthy & Zmud, 1999; Smith & Reece, 1999; Sung and Houg, 2002; Cao & Schniederjans, 2004).

The issue of alternative resource alignment has been one of the primary concerns of executives and senior managers, in general, since the mid-1980s (Luftman *et al*., 1996; Watson *et al*., 1997). Doty *et al*. (1993), reviewing their own research, indicate that increased organizational effectiveness is driven by the internal consistency or 'fit' between the various patterns of relevant contextual, structural, and strategic factors. Powell (1992) also suggests that the alignment between organizational processes and strategic decisions makes a major contribution to competitive advantage.

The importance of IS in strategic alignment also is acknowledged (Henderson and Venkatraman, 1993; Reich and Benbasat, 2000). A recent study, conducted by Lee *et al.* (2004), demonstrated that contingency and fit (alignment) theory were among the top five frequently-used theoretical framework categories out of the 31 listed among the 993 studies in the MIS field. Researchers have come to realize that an absence of strategic alignment probably can cause organizations to be incapable of realizing sufficient value from their IT investments (Henderson and Venkatraman, 1993; Woolfe, 1993). Alignment has been found not only to make a great contribution to the potential capabilities of an organization's IT infrastructure; it also exerts a significant direct positive effect on organizational performance (Azab, 2005). Conversely, misalignment in organizations results in redundancy and inefficiency in IT functions, and in an increase in costs and delays (Gold *et al*., 2001). More seriously, it can be one of the critical reasons that an organization's performance declines (Chan *et al*., 1997; Luftman and Brier, 1999).

Consistent with the vein, it's obviously that the crucial roles this three strategies play, respectively, partially determined an organizational performance. However, no matter how each one of them contributes to an organization individually, it lacks the consideration of strategic alignment among pertinent strategies. In other words, there is a necessity to evaluate whether these strategies could fit together well and levering the performance.

Research Motivation and Purpose

Over the last couple of decades, many researchers, consultants and practitioners have developed frameworks that attempt to identify the inter-correlations between IS strategy and business strategy (Marchand *et al*., 2001). However, there are still certain issues needed to be

further discussed. For example, what are the relationships among operation strategy, business strategy, and IS strategy? How do organizations truly deploy their operation strategy with business strategy and IS strategy at the same time? Furthermore, though there are numerous studies addressing the strategic alignment between operations strategy and IS strategy, operations strategy and business strategy. But, currently, there is no empirical study focusing on a holistic point of view; that is why operations strategy, business strategy, and IS strategy should fit.

Therefore, the general purpose of this study is to contribute to the academia and practice relating to operations strategy strategic alignment by pursuing two specific objectives. First, we are devoted to shedding more light on operations strategy alignment research to reflect the simultaneous and holistic pattern of inter-linkages among operations strategy and other strategies that influence operations activities. Second, it intends to provide further insights into performance implications within the broad conceptualization of strategic alignment among operations strategy, IS strategy, and business strategy.

LITERATURE REVIEW

Strategic Alignment

In general, Strategic alignment (also termed consistency, contingency, coalignment, harmony, or fit) refers to the match between (or among) a set for theoretical dimensions, however alignment is emerging as an important organizing concept in organization research (Aldrich, 1979; Fry and Smith, 1987; Van de Ven and Drazn, 1985) and strategy management filed (Miles and Snow, 1978; Venkatraman and Camillus, 1984). In spite of many terminologies was used, the meaning of alignment can be defined as the "fit" between strategy and its context—whether it is the external environment or organizational characteristics (Venkatraman and Prescott, 1990). Though this concept has been discussed many times in the past studies, a more definite definition has just emerged through the findings of Van de Ven and Drazin (1985) and Venkatraman's (1989) researches on the concept of alignment. The former defined alignment as three approaches: selection, interaction, and systems approaches and the latter used six different aspects to exam the degree of alignment which are matching, moderation, mediation, gestalts, covariation, and profile deviation. In the following paragraphs, these six methods will be discussed in order.

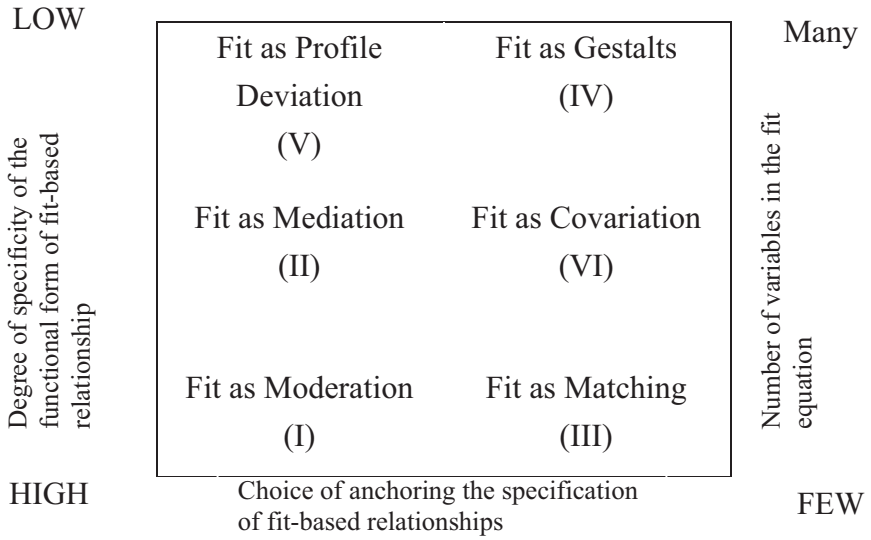

Figure 1. A classificatory framework of fit (adopted from Venkatraman, 1989)

Fit as moderation

Based on contingency theory, there is no universally superior strategy; different strategy is adopted depends on environmental or organizational context. Venkatraman(1989) said "According to the moderation perspective, the impact that a predictor variable has on a criterion variable is dependent on the level of a third variable, termed here as moderator." In another word, in this criterion-specific perspective, it is similar to Van de Ven and Drazin's (1985) definition of alignment as interaction which means alignment is the interaction between two predictor variables. To verify the alignment, analysis of variance (ANOVA), moderator regression analysis, and subgroup analysis are commonly used.

Fit as mediation

This criterion-specific perspective adopts a conceptualization based on an intervening mechanism between an antecedent variable and the consequent variable (Venkatraman, 1989) and basically intervening variable (e.g., structure) has an indirect effect on the antecedent variable (e.g., strategy) and direct effect on the consequent variable (e.g., performance). The degree of specificity of the functional form of the relationship is not as high as in the fit as moderation perspective, especially when more than two variables are incorporated in the model. Path analysis is commonly thought a suitable technique to exam the alignment as mediation.

Fit as matching

To a certain degree, fit as matching is conceptually close to the concept of selection approach

Van de Ven and Drazin proposed (1985) which alignment is the product of selection. According to Venkatraman, the fit as matching perspective is a "major point of departure from the previous two perspectives because fit is specified without reference to a criterion variable, although, subsequently, its effect on a set of criterion variables could be theoretically defined match between tow variables". Venkatraman identifies three analytical schemes for supporting the matching perspective: deviation score analysis, residual analysis and analysis of variance.

Fit as gestalts

Fit as gestalts is corresponding to Vand de Ven and Drazin's (1985) system approach oriented from the system theory that organizations must be a holistic patterns of interdependencies. From gestalts' point of view, researchers should be looking for frequently recurring clusters of attributes or gestalts; that is, the way gestalts view alignment is from a broader perspective, namely, it can be used to test multivariable (Miller, 1981). Venkatraman adopted the definition proposed by Miller and Friesen (1977) and Miller (1981) who conceptualized fit as "a set of relationships which are in a temporary state of balance" (Miller and Friesen, 1977, p.264, as cited by Venkatraman, 1989, p.432). Several taxonomical techniques are appropriate for examining this perspective of alignment such as cluster analysis and q-factor analysis.

Fit as covariation

This perspective defines fit as "a pattern of covariation or internal consistency among a set of underlying theoretically related variables" (Venkatraman, 1989). This perspective is similar to gestalts but they are different in the degree of specification of the functional form. Gestalts consider alignment as the outcome of cluster analysis, however fit as covariation is the process of factor analysis, grouping of attributes based on a set of observations (Venkatraman, 1989). It was noted in Venkatraman's study that in order to perform a rigor research, the confirmatory factor analysis (CFA) is superior to exploratory factor analysis (EFA), although both of them can be used to test this perspective of fit.

Fit as profile Deviation

Fit as profile deviation belongs to the systems approach defined by Drazin and Van de Ven (1985), namely the internal consistency of multiple contingencies. In this context, an ideal profile is assumed, and the deviation from this ideal profile expresses the degree of alignment, that is to say the more organizations' score are resemble to the ideal profile, the higher the degree of alignment organizations attain. The calculation of deviation as a Euclidean distance in an n-dimensional space is the proper analytical method for testing this perspective of fit.

Operations Strategy and Strategic Alignment Model

To retrace the definition of operations strategy, it was stated by Skinner (1969) as a company's competitive strategy at a given time places particular demands on its manufacturing function, and, conversely, that the company's manufacturing posture and operations should be specifically designed to fulfill the tasks demanded by strategic plans. In Anderson et al.'s research, the notion of operations strategy was defined as an activity which integrated business strategy, strategic production policy, and operations life-cycle. On the other hand, to address this issue, distinct typologies of operations strategy are essential. Operations strategy was divided into cost-driven strategy, market-driven strategy, and technology-driven strategy by Stobaugh & Telesio (1983). It's been gradually emphasized Sweeny's (1991) typology, including Caretaker, Marketeer, Reorganizer and Innovator. Furthermore, a convergent concept was reached, especially the one, caretaker, marketer, and innovator (Miller & Roth, 1994).

In the early stage, operations activities was not treated as important as other functional strategy, since it was argued that operations strategy can distribute a lot to business performance and operations activities begun to be put to a posture of strategy—the operations strategy (Skinner, 1969). Operations strategy has regarded as the manner in which the business units deploy its resources (Hayes and wheelwright, 1984). In fact, there are several studies interested in the operations strategy impact on business performance. For example, Wheelwright (1984) defined four competitive priorities of operations which distinctly articulate how operations can support a business performance or Smith and Reece (1999) proved that operations strategy had a positive impact on business performance. Since then, several works contribute to relationship between operations strategy and other functional strategies. Marucheck et al. (1990) concluded that operations strategy was perceived to be reactive and subordinated to business strategy. Recently, in the finding of Sun & Hung's study (2002), it mentioned the alignment of operations strategy and business strategy positively influences the improvement of business performances. The role operations strategy plays in an organization is the linkage between business strategy and internal and technological basis and to play this role, operations strategy must be in alignment with business strategy. The operations strategy research models originate with the development of a conceptual framework for operations strategy research by Skinner (1969) shown in Figure 2. As shown in Figure 2, it links a firm's operations strategy and logistic integration approach to organization performance.

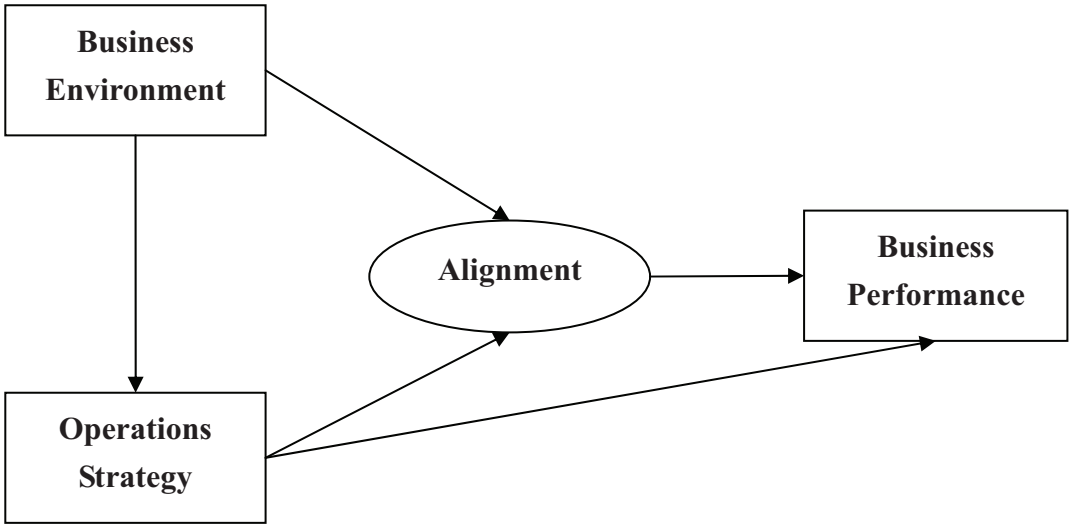

Figure 2 Skinner's (1969) Operations Strategy model.

Information System Strategy and Strategic Alignment Model

As the field of strategic management had expanded, strategic researchers and practitioners have been gradually interesting in how IS strategy works with, or even supports and shapes business strategy. In the earlier work, Venkatraman (1990) has focused particularly on the "coalignment between the strategic context and the IT infrastructure of a business" as a driver of successful exploitation of IT.

In recent years, information system has become a critical tool for the execution of business strategy and a driver of business strategy (Venkatraman, 1989). Furthermore, some conventional information systems become strategic when used in an innovated way (Wiseman, 1988). The relation of IS strategy to business strategy and the attainment of competitive advantage has been the focus of much discussion during the past two decade. In the past decade, there were some studies discussed the link between business strategy and IS strategy. (e.g. Bakos and Treacy 1986, Henderson and Venkatraman 1992, King 1978, McFarlan 1984, Parsons 1983, Rockart and Scott Morton 1984). These studies showed that there are positive relationship between IS strategy and business performance.

Besides, there are numerous frameworks and models proposed by MIS researchers. In 1991, it was proposed by Scoot Morton that a framework including five dimensions, namely structure, strategy, management process, technology and individuals and roles. (see Figure 3). In 1997, Chan et al.'s work provided a model to better understand the relationships between business strategy, IS strategic orientation and Business performance. (see Figure 4).

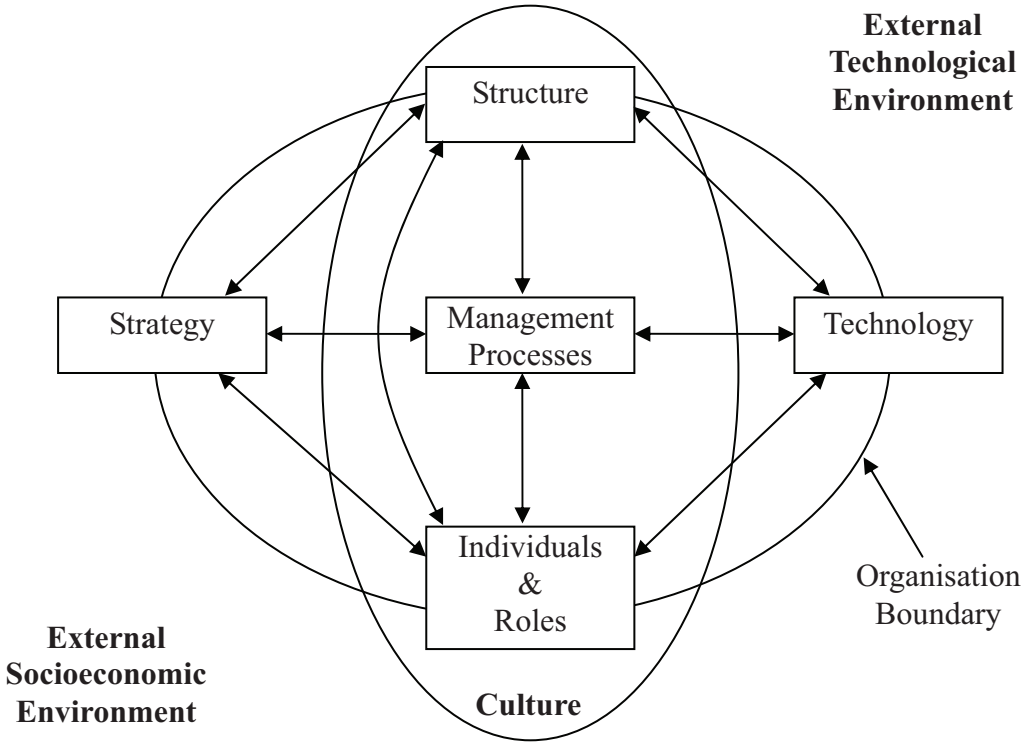

Figure 3. Five forces influence the organization's objective

(Adapted from Scott Morton, 1991)

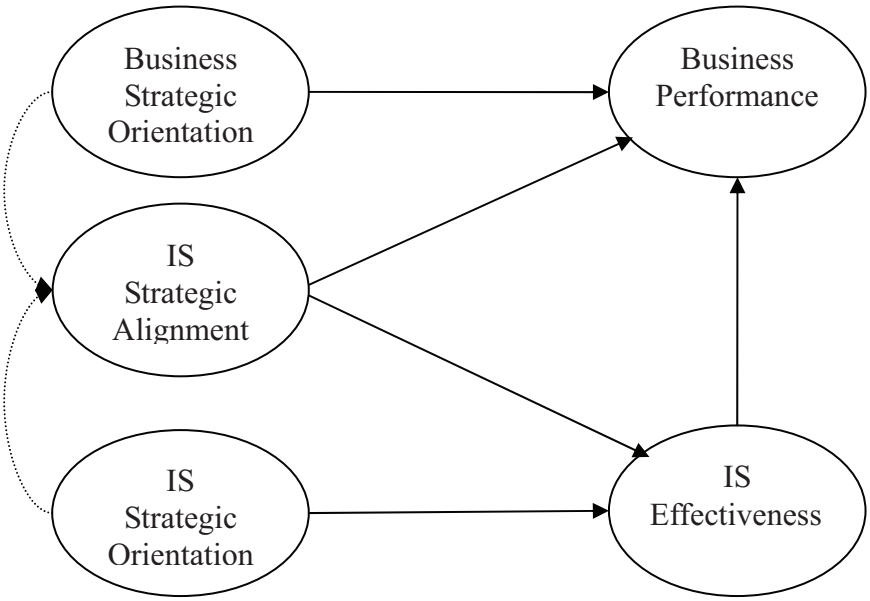

Figure 4. Chan et al. s' conceptual model (adapted from Chan et al. s', 1997)

Business Strategy and Strategic Alignment Model

Venkatraman (1985, 1989) defined the "strategic orientation of business enterprises" (STROBE) as:

> …the general pattern of various means employed to achieve the business goals, with a particular emphasis on the business-unit level of the organizational hierarchy. (Venkatraman 1985, p.52)

Thus, business strategy can be viewed as a set of means how firms compete in an industry or market (Varadarajan and Clark 1994; Ruekert and Walker 1987). In other word, business strategy is an integrated and coordinated set of commitments and actions the firm uses to gain a competitive advantage by exploiting core competencies in specific product markets, nevertheless, it is also a difficult-to-measure construct (Hambrick, 1980) that can differ from competitor within the same industry (Harrigan, 1980).

The two dominant frameworks of business strategy (Hambrick 2003) are the Miles and Snow (1978) typology, which focuses on intended rate of product-market change, and the Porter (1980) typology, which focuses on customers and competitors. Except typology,

Based on Miles and Snow's (1978) well-established typology of business strategy, including Defenders, Analyzers, and Prospectors, business strategy could be characterized as an outward technological profile contributes to organization performance directly. In a study on strategic management, Miller (1987) found a positive association between strategy and performance under various conditions. It definitely describes how an organization gains its own competitive advantage which plays a unique role in organization's performance. At the same time, it represents as the operations direction of a business toward the organization's goal. When formulating business strategy, for instance, Ansoff (1965) and Andrews (1980) emphasized the importance of aligning the organization's strategy with and internal appraisal of the firm and external assessment of environmental opportunities and threats. Therefore, alignment is important not only in developing strategies but also in their implementation.

A Holistic Perspective

As noted before, from strategic alignment perspectives, the factors influencing organization performance should be more than one single aspect. Therefore, it implies strategies somehow should fit together to create synergy in order to better perform in organizations. (Venkatraman, 1984)

Traditionally, as one of functional strategies, operations strategy was not paid enough attention; however, since it was uncovered that the important role operations strategy played in organization, there were numerous researchers devoting them to studying its impact on business performance. It, as well as, was argued operations strategy is a critical element within an organization (Skinner, 1969) and it's the linkage to corporate strategy. In addition,

since then, it has been widely believed that to a certain degree, operations strategy has not been only supporting business strategy but working with business strategy and creating synergy on performance. (Smith & Reece, 1999; Sung & Hong, 2002)

It is without questions that the importance of IS strategy on business performance has increased noticeably during past decades (Bergeron & Raymond, 1995; Henderson & Venkatraman, 1999; Porter & Millar, 1985). In addition, the manufacturing-business alignment positively influences the manufacturing contribution to the improvement of business performance. It's proved that the high-performing organizations are based on the alignment between operations strategy and IS strategy and it has positive impact on performance (Cao & Schniederjans, 2004). The framework proposed by Cao and Schniederjans is shown as Figure 5.

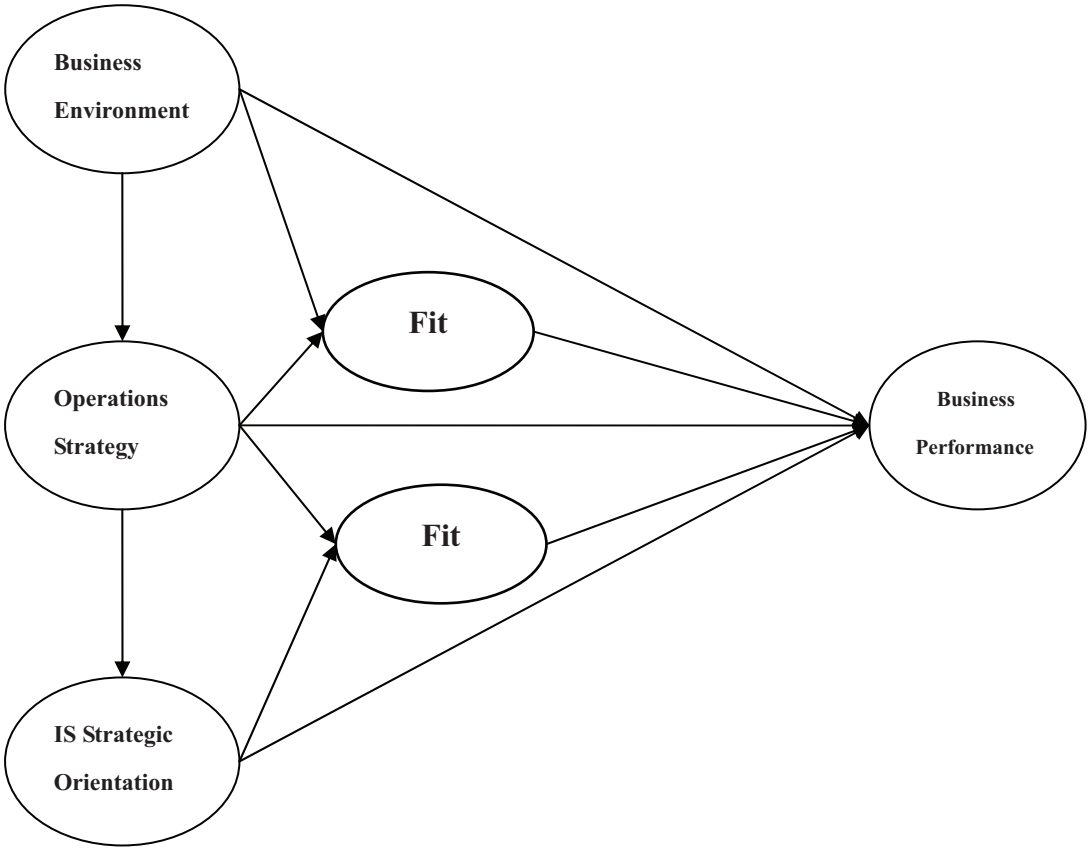

Figure 5 Cao and Schniederjans' conceptual model (adapted from Cao & Schniederjans, 2004)

RESEARCH PROPOSITION AND RESEARCH MODEL

To inherit the vein abovementioned, operations strategy, IS strategy, and business strategy occupy an important part in an organization, respectively; furthermore, they work together to

contribute toward an organization's performance. All in all, there are reasons to believe that each of them should fit together and have positive impact on organization's performance. The following proposition and an ideal framework, Figure 6, are proposed.

P1: The strategic alignment among operations strategy, business strategy, and IS strategy has a significant positive direct effect on business performance

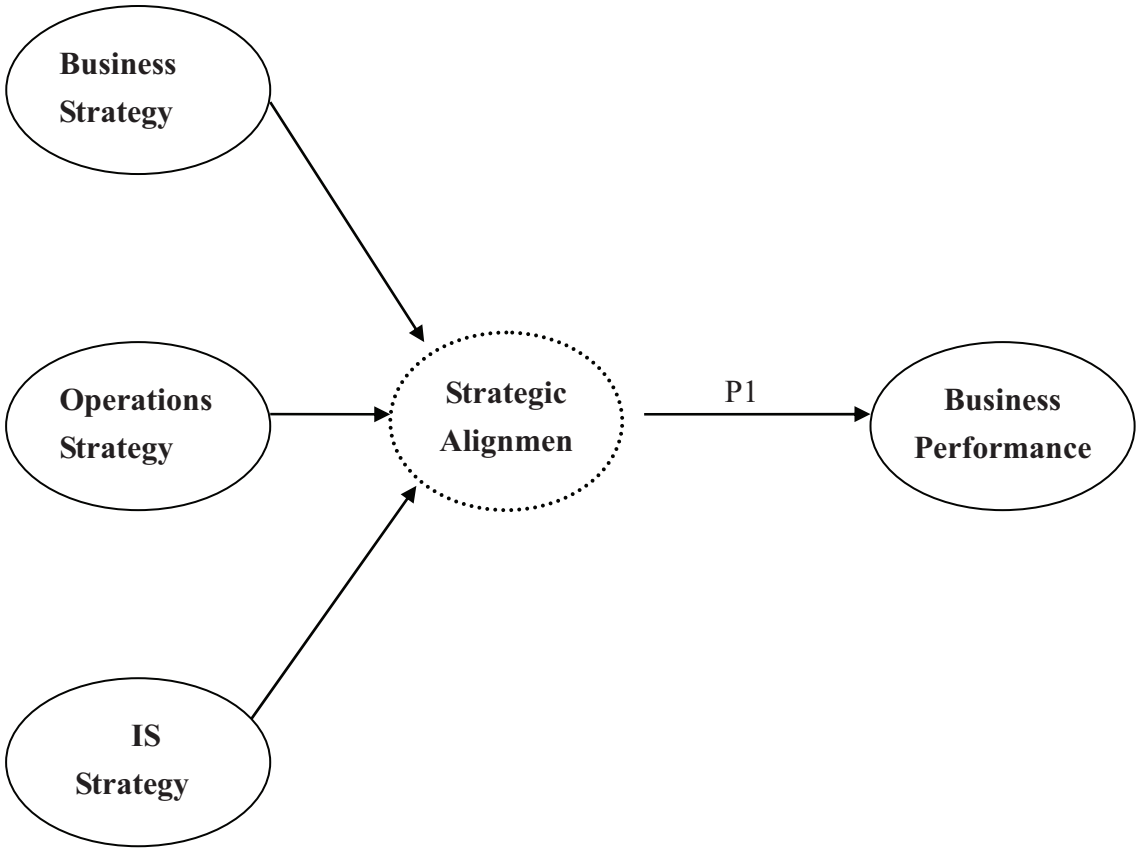

Figure 6. Research Conceptual Model

CONCLUSION

To sum up, no matter for academic filed or practitioners, there is a necessity to clarify and better understand meaning of the strategic alignment among strategies based on the reasons as follows: (1) Since each of them has significant effect on performance and even every two of them do too, should it also has an impact on performance from a broader perspective? (2) Strategic alignment view is comparatively rare discussed by researchers, not to mention being assessed via a system approach in operations filed; this conceptual model provides a well-structured starting point for future research. (3) If it does has an impact on performance,

how to define well-fitted strategies mix (or poorly-fitted) would be another interesting topic

Extension of this study would be applied with empirical data to asses this model. Through examining with statistical methods, a crystal definition of well-fitted strategic alignment mix in operations filed is expected. The outcome will definitely benefit academic research and operations practice.

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PERFORMANCE IMPLICATIONS OF FIT AMONG MARKETING STRATEGY, MANUFACTURING STRATEGY, AND STRATEGIC ORIENTATION

Dr. Yue-Yang Chen, I-Shou University, Taiwan
Dr. Hui-Ling Huang, Shu-Te University, Taiwan
Mr. I-Chen Tsai, I-Shou University, Taiwan
Mr. Che-Wei Hsu, I-Shou University, Taiwan
chenray60@gmail.com

ABSTRACT

It is noted that marketing, manufacturing and administrative– the first two reflect two important functional spheres, namely, operations and selling, while the third collectively reflect a general conceptualization of the "value-chain" of a business. Which implies three constituents of how business works – marketing strategy, manufacturing strategy, and strategic orientation. Yet to the best of our knowledge, little work has been done to exam the interrelationships from a holistic perspective. This paper tends to deepen the knowledge of performance implication of the fit among the three constituents mentioned above from a holistic perspective. We contend that this strategic alignment may contribution to business performance.

Keywords: Fit, Manufacturing Strategy, Marketing strategy, Strategic orientation

INTRODUCTION

Research background

As every parts of the world being tied together more closely, so is the business competition become more aggressive. One thing about the organization is that marketing is like the Achilles' heel to many prosperous organizations, which makes marketing too important for any organization to do without. What is marketing exactly? American Marketing Association offers the following formal definition: "Marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large" (AMA, 2007). As Kotler (1983) pointed out that the selling activities teemed in our daily life is just a "tip of the marketing iceberg". As an independent intellectual inquiry, marketing has evolved for decades. One of the great milestones of marketing chronicle delivered by Borden(1965) was "Marketing mix", an essential concept later being grouped into four categories by McCarthy known as four Ps of marketing today(McCarthy, 1996). "Product Life Cycle" is another well known work of

Levitt (Levitt, 1965). Another milestone being proposed by Boston Consulting Group in 1970s is the concept of "Strategic Marketing" and its famous BCG product portfolio matrix. By 1981, Kotler and Singh applied principles of military strategies to business situations and proposed "Marketing warfare" (Kotler & Singh, 1981). Marketing usually acts as the channel of communication between the marketing environment and customer preference and usually deals with revenue maximization, whereas manufacturing usually responsible for receiving the design for production and cost minimization (Brooksbank, 1991; Lilien & Weinstein, 1984). Though marketing and manufacturing are organizationally separate in most firms (Karmarka & Lele, 1989), without effective co-ordination of those two functional entities could potentially jeopardize organization's survival in the marketplace (Mukhopadhyay, 1998). Therefore, the strategic alignment between marketing and manufacturing strategy is a crucial issue for academic and empirical practice.

Few would argue that the most crucial problem an organization could get into today is the management of change. However, how to formulate an overall strategy that exploiting synergy from different functional entities within an organization is still difficult to achieve yet so far. To cope with volatile market situations, organizations have been examining decision making for decades from various facets. AS Schendel and Hofer (1979) point out that the manner which a firm position itself competitively, whereas Porter stated "A corporate should seek to respond to the external environment effectively to gain competitive advantages or the competitive forces" (Porter, 1990). Though the definition varies, all of them served the same interest - focusing on how to better deal with competition and maintain competitive advantages simultaneously (Milosevic & Srivannaboon, 2006). Among all the typologies proposed, Miles and Snow (1978) and Porter (1980) typologies, which are being called "business strategy" have been considered two dominant categories of business strategy.

A fact in most companies is that the great bulk of the asset used - the capital invested, the people employed, and management time - are in the operation side of the business. This is true of both manufacturing and service organizations, in both the private and public sector of our economy (Hayes & Schmenner, 1978). It is apparent that the manufacturing is an indispensable constituent to the success of an organization as a whole. Ever since Skinner's famous work back in 1969, manufacturing strategy have been getting spotlight from researchers in related fields. The definition of manufacturing strategy was stated by Skinner as "a company's competitive strategy at a given time and places particular demands on its manufacturing function, and, conversely, that the company's manufacturing posture and operation should be specifically designed to fulfill the tasks demanded by strategic plans" (Skinner, 1969). As he pointed out in his another work in 1974 that no company can perform well on every yardstick. An organization can only outperform its competitor by focuses on a

narrow product mix for a particular market niche with the premises that each of its key functional area (e.g. marketing, manufacturing, sales…etc) in operation activities must have the same objective (Skinner, 1974), in addition, the type of manufacturing strategy of a firm used must be complied with its chosen competitive strategy (Amoako-Gyampah & Acquaah, 2008; Sun & Hong, 2002). Consequently strategic orientation of a business should be in line with manufacturing and marketing strategy.

It is widely recognized that the use of contingency theory is a strategy that most organizations adopt toward the competitive environment which varies in a minute basis. Strategic alignment (or fit) is considered as the central thrust in many management disciplines, especially in strategic management field (Delery and Doty, 1996; Venkatraman, 1984). Doty et al. (1993), reviewing their own research, indicate that increased organizational effectiveness is driven by the internal consistency or 'fit' between the various patterns of relevant contextual, structural, and strategic factors. Usually organization's performance is determined by how effective the organizational structure is being implemented, and that depends on how the functional entities are being organized (Mintzberg, 1979; Ward et al.1996). In other words, through coordinating subsystems within the organization with a variety of different strategies, superior organizational performance can be achieved (Venkatraman, 1990).

Problem statements

Strategy is rooted as a concept to match or align organizational resources with environmental opportunities and threats on an ongoing basis (Venkatraman, 1984). As many studies have either implicitly or explicitly employed the concept of fit, it occupied a central role in many strategic management fields (Venkatraman, 1984). Though theories vary widely in subject matter, they share the common proposition that an organizational outcome is the consequence of a strategic alignment between two or more factors or dimensions (Van de ven & Drazin, 1985).

According to Venktraman (1990), marketing, and Manufacturing reflect two important functional spheres, namely, operations and selling, while the strategic orientation captures the "generic typologies" of organizations. An effective strategy of a business is the one that collectively reflects consistency or coherence among these three dimensions mentioned above. Moreover, due to the concept of strategic alignment has not been adequately clarified when employed in the various social science streams (Venkatraman, 1984), the above mentioned strategic alignment of the three constructs is in the need.

Research Motivation and Purpose

Consequently, the general purpose of this study is to contribute to the academia and practice relating to strategic alignment by pursuing several specific objectives. First, this study tend to shed new light on marketing strategic alignment research to reflect the simultaneous and holistic pattern of inter-linkages between Marketing strategy and other strategies, which refers to Manufacturing strategy and Strategic Orientation. Second, it intends to provide further insights into performance implications within the broad conceptualization of strategic alignment among Marketing strategy, Manufacturing strategy, and Strategic orientation.

LITERATURE REVIEW

Strategic alignment

The basic theme of alignment is generally understood in its metaphoric form and it is common for theorist to postulate relationships using words and phrases such as matched with, contingent upon, consistent with, congruence, fit, or alignment (Venkatraman, 1989). The concept of fit has served as an important building block for theory construction in several areas of research (Aldrich, 1979; Fry& Smith, 1987; Van de Ven & Drazin, 1985). In general, the idea is the efficient alignment of organizational resources and capabilities with environmental opportunities and threats (Andrews, 1980; Bourgeois, 1980; Schendel and Hofer, 1979), it is a match between (or among) a set of theoretical dimensions (Venkatraman, 1990). It is important from two perspectives in the organizational theory literature—descriptive and normative. The descriptive perspective specifies the existence of relationships among a set of theoretically-related variables without any explicit linkage to performance. The normative perspective develops an explicit link between coalignment and performance (Venkatraman, 1990). Venkatraman and Camillus (1984) made an initial attempt to distinguish between the 'content of fit' and the 'pattern of interactions' in 1984. Coalignment is between strategy and one or more relevant constructs in former perspective. The invocation of fit is external to the definition and operationalization of strategy. The latter perspective possessed that strategy is not viewed as a concept that is separable from the conceptualization of fit, coalignment is intrinsic to the conceptualization and operationalization of strategy itself.

Grant and King (1982) proposed that strategy is a timed sequence of internally consistent allocation of resources to achieve an organization's objectives (Venkatraman, 1982); internal consistency refers to the coalignment among decisions in key areas of operations and functions. Gupta's research in 1984 also proposed basic propositions that link strategy and managerial characteristics with explicit linkages to performance. In 1989, Venkatraman has identified six perspectives of fit as follow: fit as moderation, fit as mediation, fit as matching, fit as gestalts, fit as profile deviation, and fit as covariation (Venkatraman, 1989). A

conceptual framework is attached as follow in the Figure 1.

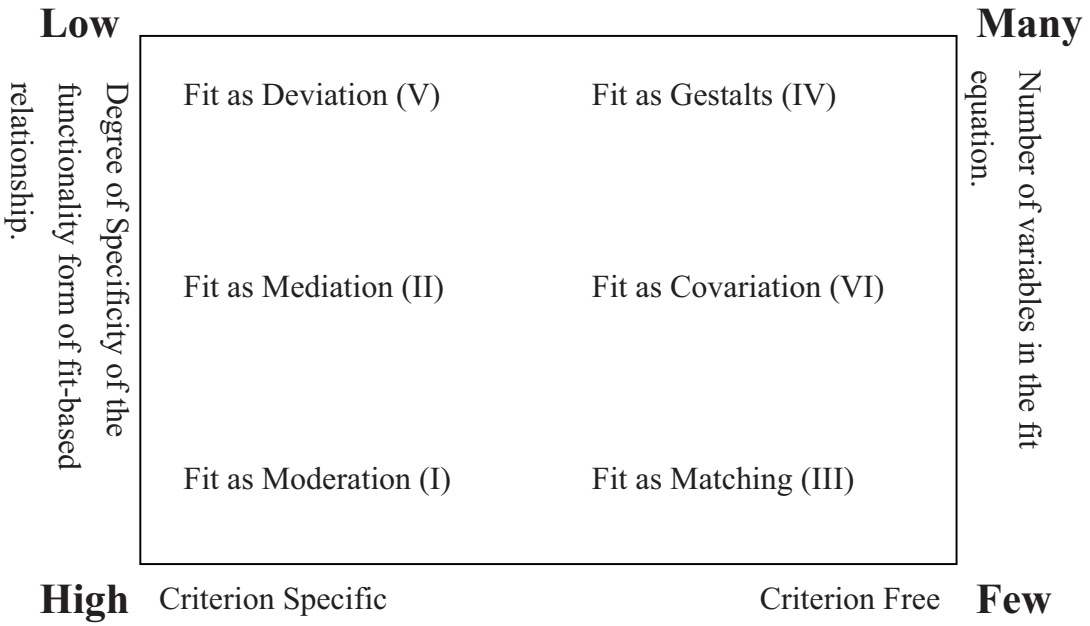

Figure 1. Conceptual framework of strategic alignment

Fit as Moderation

As investigators hold a contingency perspective, the impact that a predictor variable has on a criterion variable is dependent on a third variable, termed as moderator (Venkatraman, 1989). Fit as moderation is criterion-specific, and is conceptualized as the interaction between two variables. The impact a predictor variable has on a criterion variable is dependent on the level of a third variable. In other words, the moderator can be viewed either categorically or characteristically, and it will influence the direction and strength of the link between Independent Variable and Dependent Variable.

Fit as Mediation

While moderation specifies varying moderating effects of moderator to the relationship of IV - DV, this mediating perspective focus on the existence of a significant intervening mechanism between antecedent variable and the consequent variable. The relationship is not as high as the fit as moderation, especially when more than two variables are incorporated in the model. The distinction between complete versus partial mediation has important theoretical implication on managerial perspective.

Fit as Matching

Fit is considered a theoretically defined match between two related variables. The major departure of this perspective is that fit is specified without reference to a criterion variable.

The measure of fit between two variables is developed independent of any performance anchor. The fit as matching model is attached as Figure 2.

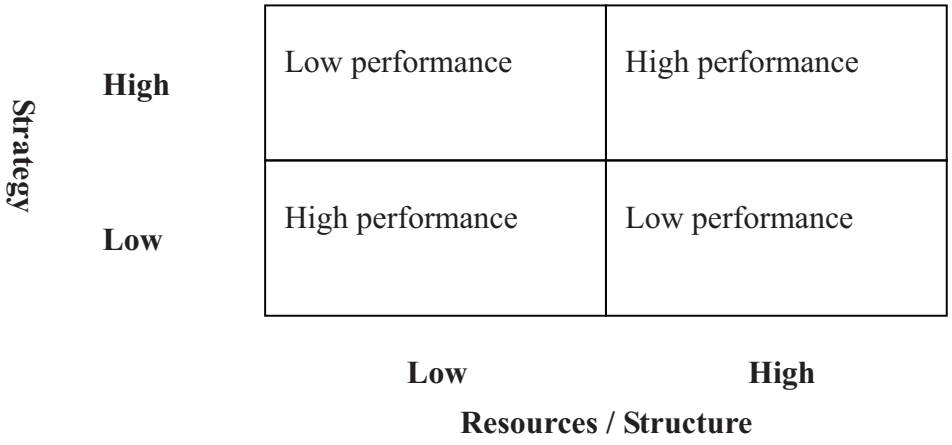

Figure 2. fit as matching model

Fit as Gestalts

Miller describes the role of gestalts as "Instead of looking at a few variables or at linear associations among such variables we should be trying to find frequently recurring clusters of attributes or gestalts".

Fit as Deviation

Similar to Van de Ven and Drazin's patter analysis, fit as deviation refers to the degree of adherence to an externally specified profile with anchoring to a certain criterion. Assumed an ideal profile, and lower performance should result from deviation from the ideal profile.

Fit as Covariation

The concept of fit as covariation is akin to Mintzberg's megastrategy, which means to make an effective strategies, it requires consistent attention to all areas of a strategy. Only focus on any one area is insufficient.

Manufacturing strategy

As academics gradually picked up interest on the importance of manufacturing strategies, researches in the field has increased significantly over the past decades. Research stream in manufacturing strategies has focus on the alignment of strategic priorities and its impact on performance, let along the importance of the alignment between strategies. The strategic

view of manufacturing strategy dates back to Harvard in the 1940s and 1950s where researchers observed different ways companies chose to compete within different industries (Voss,1995). With Skinner's contribution in "Manufacturing— missing link in corporate strategy" and "The focused factory" which not only set out the importance of explicit linkages between manufacturing choices, firm's environment, and corporate strategy, but also developed the concept of focus and of internal and external consistency (Voss,1995). Later Wheelwright also support that the manufacturing strategy should be in alignment with business strategy (Wheelwright, 1984).

Manufacturing strategy process, content and implementation determine how resources and capabilities are to be deployed within organizations to complement the business strategy (Hayes and Wheelwright, 1984). The major benefit of manufacturing strategy is that it provides a means for focusing the attention of corporate management on manufacturing concerns (Leong and Ward, 1994). Manufacturing strategy content embodies the choices of the most beneficial set of manufacturing capabilities for a business unit and the investments needed to build that set of capabilities (Ward, Bickford and Leong, 1996). Manufacturing capabilities are best conceived as stocks of strategic assets which are accumulated through a pattern of investment over time and cannot be easily imitated or acquired by trade, nor can good substitutes be found (Ward, 1996). Manufacturing strategy provides a competitive weapon in the organization's strategic planning if utilized properly (Skinner, 1969).

Marketing strategy

According to the definition of marketing proposed by Philip Kotler's: "marketing is the analysis, planning, implementation of carefully formulated programs designed to bring about voluntary exchanges of values with target markets for the purpose of achieving organizational objective" (Kotler, 1983). Marketing strategy is a set of integrated decisions and actions (Day, 1990) by which a business expects to achieve its marketing objectives and meet the value requirements of its customers (Cravens, 1999). As organizations only have limited resources, market segmentation and targeting is a necessity for firms to commit limited resources only to satisfy certain particular customer group. Marketing Orientation (MO) is considered by many as a measure of the behaviors and activities that reflect the marketing concept (Hunt & Lambe, 2000). However, marketing is not only a strategy or a concept, but a philosophy that is a cornerstone of successful firm's cultures (Hunt & Lambe, 2000). A concept that could lead firms to better understand and meet the needs of their target customer group by putting customers in the center of the firm's operation and strategy formulation (Deshpande & Webster,1989).

Strategic Orientation

There can be little doubt about that, by developing a business strategy, the organization determines how a strategic business unit (SBUs) support organizational goals, competitive direction, its scope, and how it will seek competitive advantages (Garvin, 1993). Business strategy represents the way that a business positions itself to its competitors, and how it confronts with the future challenges. Without a strategy, organization might find itself in a dilemmatic situation of conflict its short-term decisions with long-term goals (St John and Young, 1992). Business strategy is the outcome of a complex processes of decisions made to guide an organization with respect to the environment, structure and processes that influence its organizational performance (Croteau and Bergeron, 2001). Miles and Snow (1978) identified four archetypes of how firm address in market domains and construct structures and processes to achieve success. Prospectors continuously seeks to locate and exploit new product and market opportunities while Defenders attempt to seal off a portion of the total market to create a stable set of products and customers. Analyzers occupy an intermediate position between the two extremes by combining the strengths of both the Prospector and Defender to cautiously follow Prospectors into new product. The Reactor, does not have a consistent response to the entrepreneurial problem.

Strategic Alignment Models

Through 1990s, a number of prior researches have focused on logistics practices and internal congruence. By 2000, Stock et al. proposed a framework that links a firm's supply chain structure and logistics integration approach to organizational performance as showed in Figure 3.

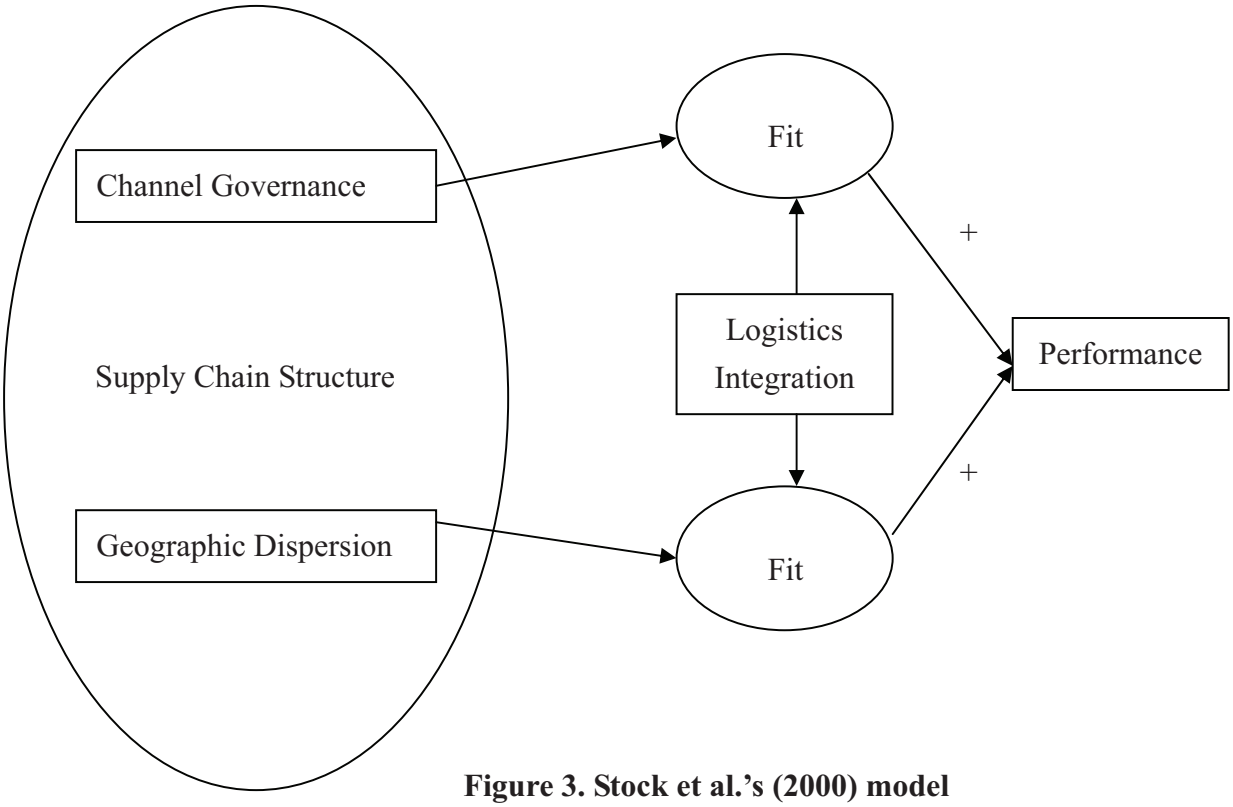

Figure 3. Stock et al.'s (2000) model

Sun (2002) articulated that the alignment of manufacturing strategy and business strategy positively influences the improvement of business performances, and the manufacturing-business alignment also positively influences the manufacturing contribution to the improvement of business performances in his research, which focus on the alignment between manufacturing strategy and business strategy on business performance and the contribution of manufacturing performance to business performance. The concept framework is shown as Figure 4.

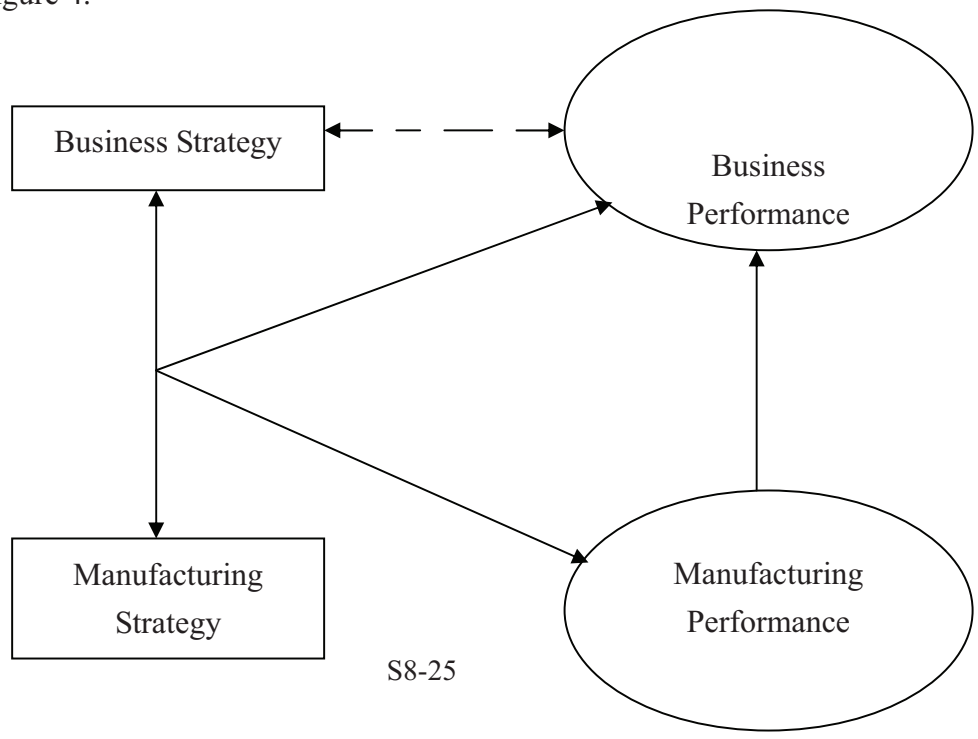

Figure.4 Sun's (2002) model

In 2005, Steven exemplified the existence of fit between the strategies followed by firms and the manufacturing technologies they employed, and proven the quality of the linkage was shown to relate to financial performance. The proposed figure is shown in Figure 5.

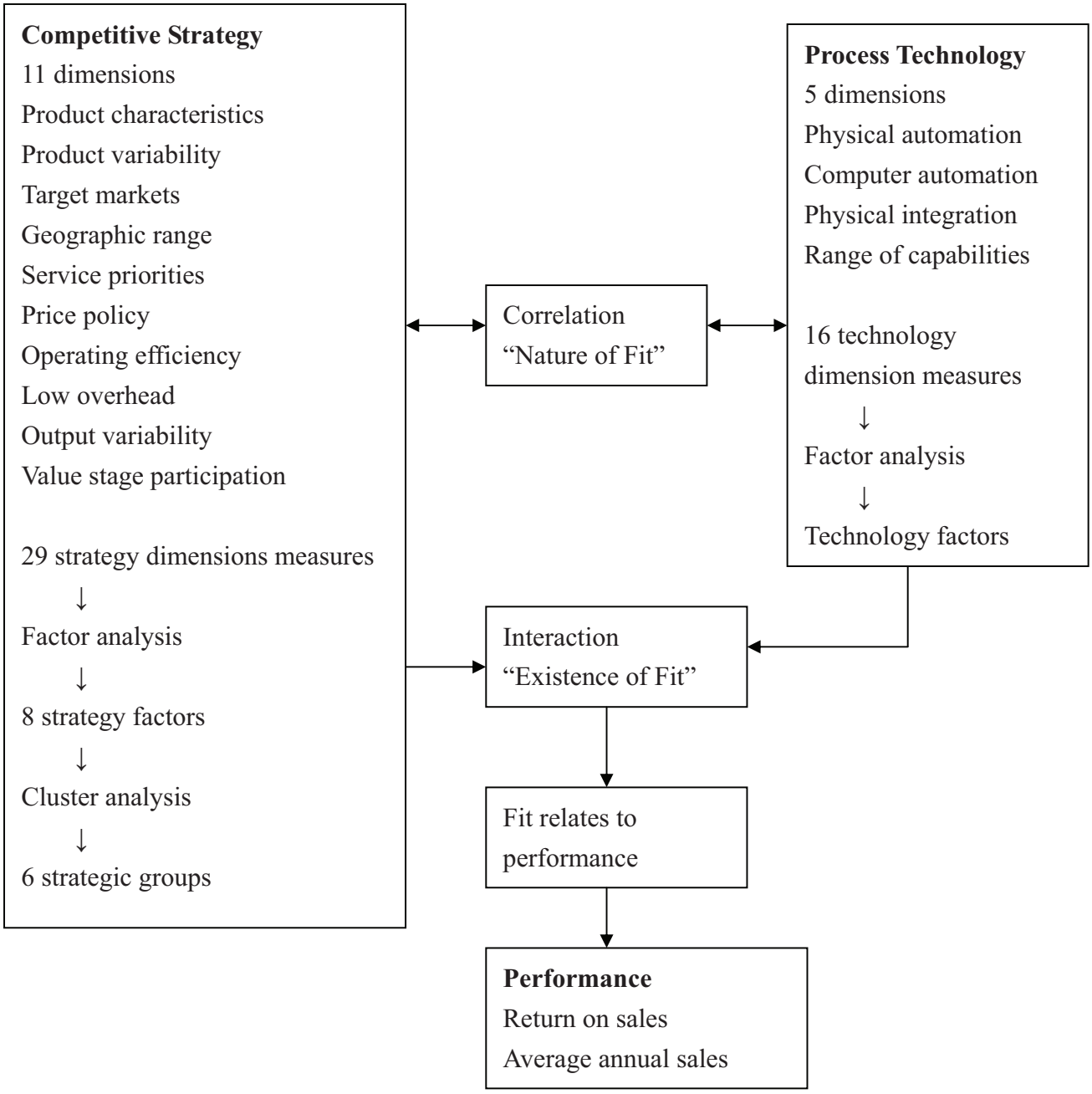

Figure.5 Steven's (2005) model

As indicated by Varadarajan' (1999), marketing plays an important role in the strategy formulation process and the determination of strategy content at the business and corporate

levels, rather than just being responsible for the content, process, and implementation of marketing strategy at the product-maker level (Varadarajan, 1999). Another research conducted by Slater in 2001 also exemplified that marketing strategy should not be considered independently of their business strategy. The implementation of business strategy addressed how marketing activities are accomplished (Slater & Olson, 2001).

An empirical research conducted by Berry et al. (1999) articulate that lack of alignment in marketing and manufacturing could leads to failure in achieving their strategic business objectives (Berry et al., 1999). The proposed framework is shown in Figure 6.

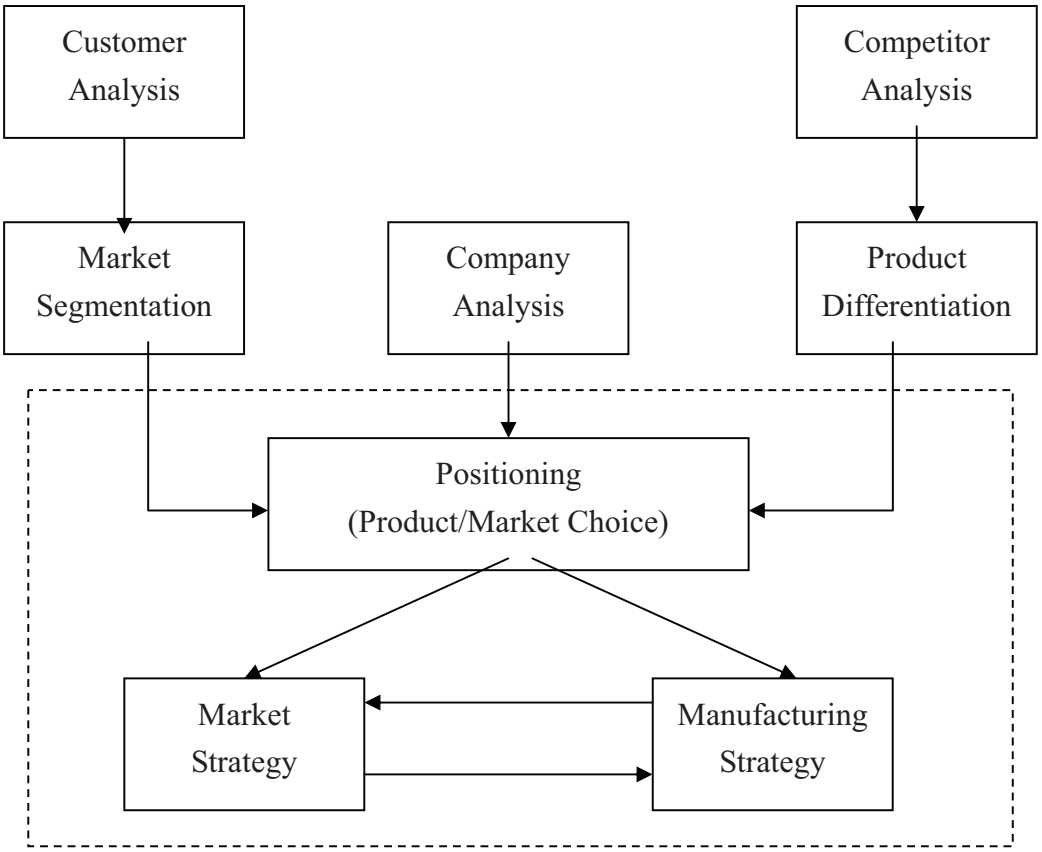

Figure. 6 Berry et al.'s (1999) model

METHODOLOGY

As the discipline and practice of marketing has been undergoing a period of metamorphosis over the last four decades (Varadarajan, 1999). As theory is developed, knowledge enhances and spawns new questions requiring different explanations demanding even greater advances in knowledge; the role of marketing nowadays has become one of the key functional entities within the firm. For more than forty years, the marketing concept has been considered the cornerstone of marketing, which is highly strategic in nature (Hunt & Lambe, 2000).

Jaworski and Kohli (1993) also pointed out that the marketing concept was an important antecedent of business strategic success. The contributions of modern business strategy have come from a broad range of disciplines, and manufacturing is an indispensable part. Sun (2002) has generated the result that only when the manufacturing strategy and business strategy are fit, can manufacturing contribute to the improvement of business performance and business objectives can be achieved. Consequently, this leads to research assumes that the various patterns of marketing strategy, manufacturing strategy and strategic orientation must be in line with each other to optimize the organizational outcome. The following preposition is proposed:

P1: Fit among manufacturing strategy, marketing strategy, and strategic orientation has a significant and positive direct effect upon business performance, in terms of growth and profitability.

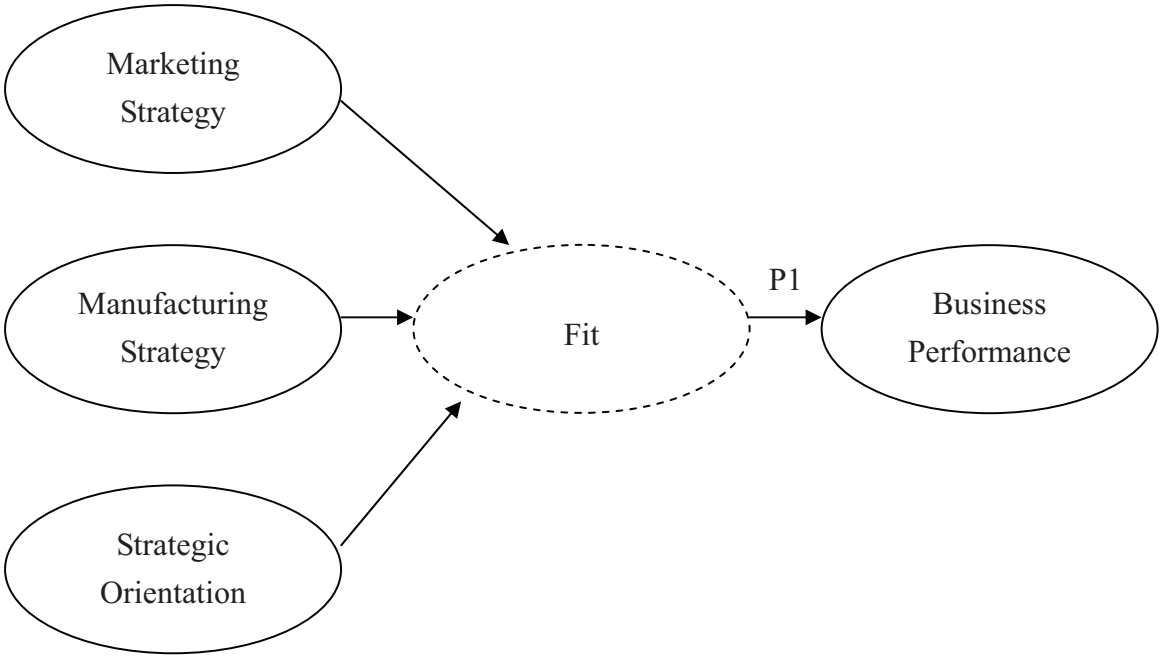

Figure 6. Strategic Alignment Model– Holistic perspective

Therefore, a fit model that articulates the combination of manufacturing strategy, marketing strategy, and strategic orientation is proposed.

CONCLUSION

Understanding the requirement of a successful fit among strategies is of interest to both practitioners and academics, yet the field of strategic alignment is still in its infancy. The

overall picture emerging from this study highlights the performance implication of fit among three aspects, namely Manufacturing strategy, Marketing strategy, and Strategic orientation, from a holistic perspective.

To our knowledge, this is the first study offering performance implication of fit among those three dimensions from a holistic perspective. Yet further empirical study is required to exemplify the correctness of this model and by conducting alternative perspective of fit with statistic analysis, it is possible to find a more proper fit that has more significant effect on performance implication.

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ELEMENTS OF STRATEGIC MANAGEMENT OF TECHNOLOGY IN HIGH-TECH SME PRACTISE

***Kari Sahlman, Nokia Siemens Networks, Finland**
kari.sahlman@nsn.com
Harri Haapasalo, University of Oulu, Finland
harri.haapasalo@oulu.fi

ABSTRACT

Strategic management of technology is a necessity for wealth creation in society, but also in corporations as members of that society. Emergence of new economical order enabled by global competition and proliferation of information involves increasingly rapid changes in technologies which causes major competitive challenges to enterprises to manage their technological capabilities. Effective and efficient management of technology practises are crucial especially for small and medium-sized enterprises at all life-stages due to critical role of technology in the companies. In the absence of commonly agreed management of technology frameworks this study discovers perceptions and current state of management of technology in high-tech SMEs. Theoretical background of this study is based on a conceptual framework of strategic management of technology originating from large enterprise practices. The elements are classified with respect to structures, objectives and company internal and external impacts. Companies in this research unanimously consider management of technology important for competiveness and business success. Conceptually entire field is perceived to be complex and there is contingency and immaturity in practises deployment in SMEs. As a conclusion it is suggested that SMEs should consciously develop management of technology practises, and the presented structures elements of strategic management of technology framework would provide a frame of reference when constructing the practises in enterprises. It is also proposed that strategic management of technology should be evolved as a distinguishing functional and managerial domain that enhances the management paradigm of multifunctional strategic orientation in enterprises.

Keywords: Strategic management, management of technology, MoT, technology management framework, element, SME, enterprise, enterprise development.

INTRODUCTION

Enterprise competitiveness and value creation is in the long-term enabled by successful execution of company's strategy in which technology is a critical resource. Competitive environment is involving increasingly rapid changes in technological, social and economical circumstances. Effective and efficient technology management practises are especially important for small and medium-sized enterprises (SMEs) during all life-stages of an enterprise due to the critical role of technology in entrepreneurial activities and lack of possibilities to miss. Capability of strategic management of technology is an imperative for sustained competiveness and performance of an enterprise (e.g. 18, 26). Complexity of the subject and missing comprehensive frameworks give rise to managerial challenges for practitioners. Therefore a consistent framework with substantial insights on what are the elements of strategic management of technology is needed. Absence of commonly agreed theoretical frameworks leads into introduction of diverse empirical solutions (19), which do

not properly address environmental, economical and social aspects either (5). According to Drejer (9) common perceptions of technology and management of technology are not well suited for coping with the complexity, and SMEs have to face similar problems as large enterprises even with more limited resources (23). The practical problem for enterprises is to define what elements are needed for strategic management of technology in order to establish or improve the practises in a company. There is also an identifiable separation between technology management and business planning in the small high tech firms (3) which may lead into competitive disadvantage. For smaller companies it is somehow difficult to imagine the technological cycles and continuity of technologies.

The purpose of this research is to study perceptions of management of technology and current state and importance of the structures elements of strategic management of technology framework in small and medium-sized high-tech enterprises. The research problem is formulated as the following research questions:

RQ 1: *What is the perception of management of technology in SMEs?*
RQ 2: *What is the current state and importance of the structures elements of strategic management of technology in SMEs?*

In this paper first the context of management of technology and the strategic management of technology framework is presented. The framework for strategic management of technology has been developed based on conceptions of large enterprise representatives. The framework is based on literature, integrated management theory (4) and large enterprise practises, and it describes elements of strategic management of technology as classified to structures, objectives and impacts. This study is performed in order to increase theoretical and practical validity of the framework in different enterprise scope. It was expected that SMEs are strategically focused enterprises and concentrating on the most essential activities for the company's success, therefore findings on technology management activities among SMEs would reveal the most important ones. The empirical study was carried through in Small and Medium-sized Enterprises to study what is the importance and current state of the elements of strategic management of technology structures in SMEs, and what is the perception of management of technology in those companies.

CONTEXT AND CONCEPTUAL FRAMEWORK OF STRATEGIC MANAGEMENT OF TECHNOLOGY

Strategic management of technology in context of enterprise management

Strategic management of technology within a company contains aspects of explicitly linking business strategy with products and required technologies. Technologies develop and operational environment of an enterprise changes even at an accelerating speed due intensified competition. Thus efficient and effective management approach is needed for management of technology which is more complicated than traditional management of research and development due its dynamics and fundamental impacts on company's strategy, products, competitiveness and people's knowledge. Strategic management of technology in form of processes and practices shape capabilities of a company internally and with respect to its socio-economic environment, therefore it is practically intertwined with all management activities and operations of an enterprise. Views to enterprise management are presented in figure 1 to outline the context of strategic management of technology.

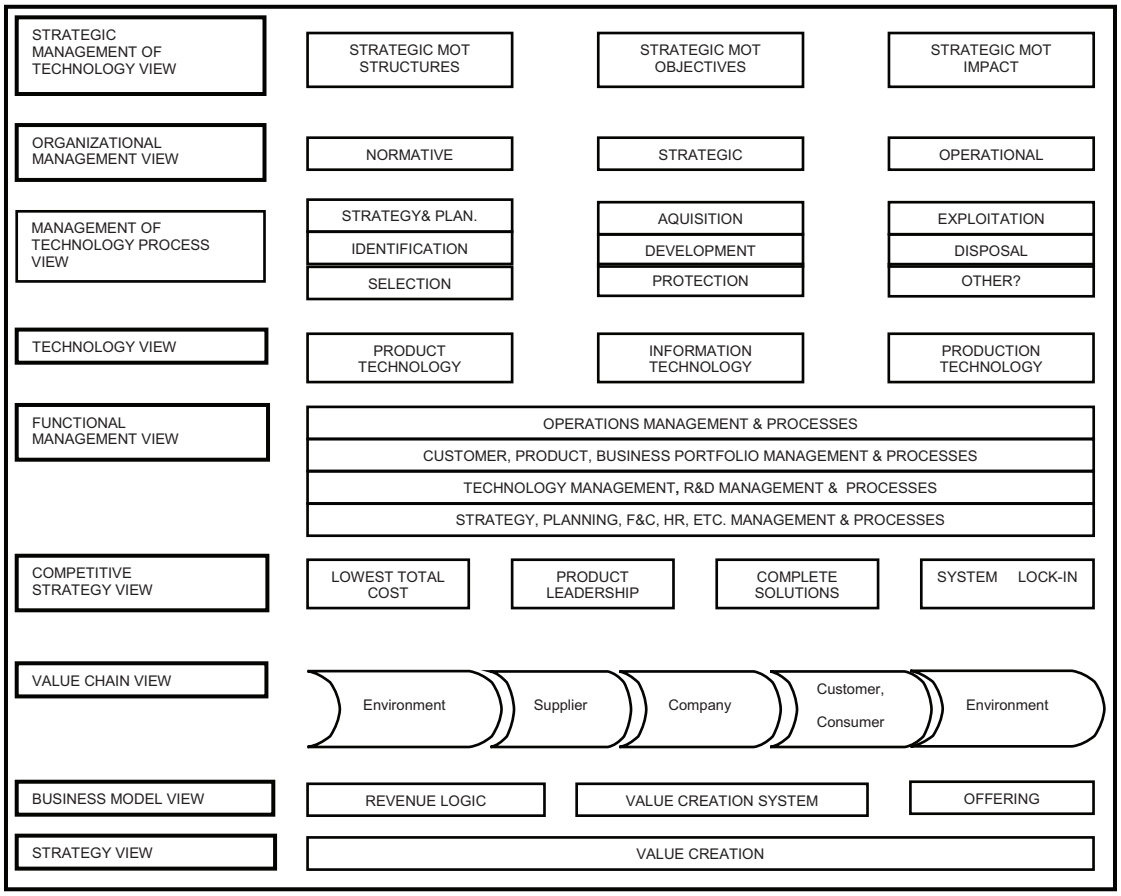


Figure 1: Views to enterprise management in context of strategic management of technology

As classically defined, strategic management concerns company's initiatives taken by management to create, enhance and sustain its capabilities regarding to its environment and to reach company's objectives (1). From strategic management perspective the mission of an enterprise is to create value for owners, personnel, customers, suppliers and society (e.g. 13). To create value a company has to determine and structure its position in the value chain through defined strategies and operationalized actions that execute the strategy. Objects to be created and managed to accomplish company's mission and to place it in a value system are defined by a business model view. It consists of offering, value creation system and revenue logic (25). Offering defines what physical, information or service composition is pursued. Value system describes the value creation structures and networks that are needed to capture the value. It includes relationships to customers, suppliers, collaborators and competitors. Pre-requisite to value capture, cost structures and competitive strategies of the company is set by the revenue logic. Value system can be viewed next as a value chain and network of actors (e.g. 12, 16), including environment as a source for raw-materials and as an object coming in for disposal and waste management of the products. Different types of technologies are involved in enterprise value chain activities and thus need to be managed for fulfilling customer needs (20).

Strategic management of technology covers technology aspects of company's offering, value creation system and revenue model, which are determined by which business company is in and by what competitive strategy a company is driving for. Lowest cost, product leadership,

total solutions offering and system lock-in strategies set different requirements for the technologies and capabilities a company should develop and possess (13). Offensive, defensive, imitative, dependent or opportunist technology strategies require different policies for technological investments and mix of technology portfolio (8).

For creation of value a company can be structured according to perspectives of customer, financial, internal and learning processes (13) which are intended to be executed as cross-functional and cross-organizational processes. Depending on the organizational structure of a company, from view point of functional management enterprise may have operations management, customer, product and business portfolio management, R&D management, strategy management, human resources, financial, accounting and other support types of management functions and corresponding organizations. Typically technology management is not organized as its own function or organization but it is often embodied in R&D function. Strategic management of technology imposes a major paradigm change on organizing it as a distinguishing function in an enterprise.

Technology can be categorized to product technology, manufacturing technology and information technology (24) and it is embodied in people or systems as explicit artefacts or tacit knowledge (6, 14). Technology management can be seen as activities being involved from research to development of technology for products throughout to commercialisation and abolishment of the products. Activities of identification, selection, acquisition, protection and exploitation (11) and technology strategy creation, technology development and disposal (22) cover management of technology activities. Integrated management theory model (4) defines normative, strategic and operational areas of an enterprise management. They all have structural, objectives oriented and behavioural elements. And finally, management is planning, organizing, leading and controlling activities completed through people (21). Within this context, as presented in figure 1, elements of strategic management of technology structures, objectives and impacts form a framework for strategic management of technology.

In this research definition of strategic management of technology is derived from definitions of technology, strategy and management and it is defined as:

> *"Strategic management of technology is management of technological activities interacting with company's technology infrastructure and socio-economic environment to contribute to formulation and execution of company's strategy."*

In the longer form where the terms management, technology infrastructure and strategy have been opened, strategic management of technology is defined as:

> *"Strategic management of technology is planning, organising, leading and controlling of technological activities interacting with company's skills to apply knowledge, structures, resources and socio-economic environment to contribute to formulation and execution of company's basic, long-term goals and objectives, and adoption of courses of action and the allocation of resources necessary for those goals."*

Strategic management of technology framework

Strategic management of technology framework is presented in figure 2. It defines elements of technology infrastructure that consists of internal and external structures, resources and capabilities, objectives and internal and external impacts within the company and towards its environment. The framework is building on studies of Luggen and Tschirky (17), and the framework is applied and amended by Sahlman and Haapasalo (22) to comprise sub-

structures and to consider company internal objectives, structures and impacts to external industry environment. In the following is presented key principles of the framework.

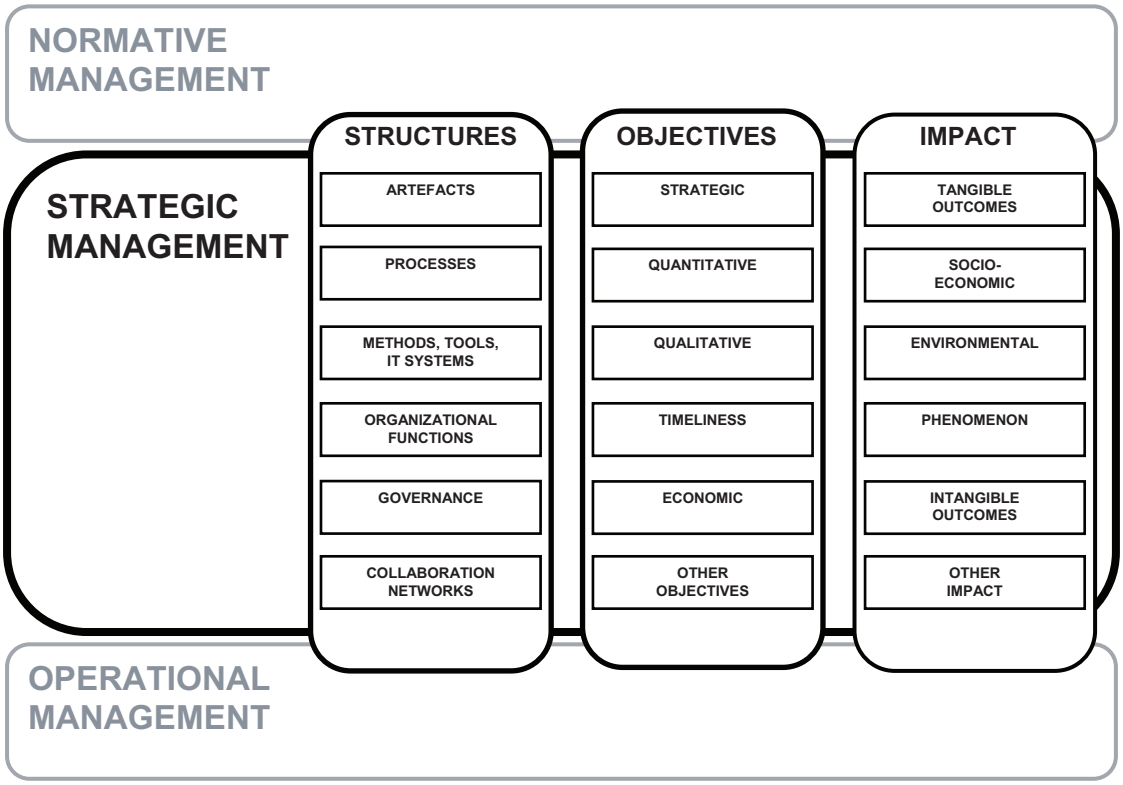


Figure 2: Strategic management of technology framework

The framework is a conceptual model that describes hierarchical structure of the elements in an open system. Each column represents categories that constitute elements of strategic management of technology. Major categories are structures, objectives and impacts. They can be classified into sub-categories that contain the elements at the next level of detail, and theoretically structures, objectives and outcomes are the classified key viewpoints to technology management. The conceptual model describes what the elements of strategic management of technology are, but the framework does not describe how the elements function. Actual implementation of management of technology practises depend on the company mission, business, size, maturity and environment it operates in.

Operational activities using processes, practises and methods produce documents, intangible and concrete outcomes. These activities form and shape the company's technology infrastructure or are manifested as outcomes that are delivered externally. Objectives of strategic management of technology are classified to strategic, qualitative, quantitative, economical and timeliness. Objectives need to conform to company's strategic objectives and to contribute on definition, execution and shaping of the strategy. Impacts of strategic management of technology can be divided into tangible and intangible outcomes, which consequently through operational activities have impact to company internal capabilities and to its external socio-economic environment. In the following the structures elements part of the framework is described in more details and the proposed classification is presented in table 1. Classification is not asserted to be exhaustive.

In the framework the major categorization of technology management processes contains processes of technology strategy creation, planning, identification, selection, acquisition, protection, development, exploitation and disposal of technology. Each of the processes typically can have several sub-process or practises e.g. identification of technologies consists of practises for technology scanning, scouting, monitoring and forecasting. Artefacts, as classified in the framework, are the typical and major outcomes of the operative technology management activities that are using the processes. All the artifacts need to be included in the technology infrastructure of the company and be strategically managed. Creation and utilization of the artefacts requires appropriate methods, tools and IT systems for data and knowledge management. Methods, especially for collection and analysis of information, are needed for operational activities and planning methods are needed for managerial tasks. Engineering methods and tools are required for research, selection, creation and development of technologies. Data and knowledge management systems form the IT backbone of the technology infrastructure and are used for storing and co-ordination of the planning and exploitation of technological assets of the company.

Organizational structure for technology management functions depend on the business, size, traditions and principal decisions about the degree of centralization and de-centralization of the business units and other functions in an organization. Technology management is seldom recognized as a discipline of its own, whereas functions like research, product development, product management and business management and human resources management are organized as separate entities. Processes of strategic management of technology require corresponding management organization and personnel for planning and operative execution of strategic management of technology objectives. Company needs also to manage related operational activities like research, technology development, intellectual property and collaboration management. Governance structure, principle models and criteria are for decision making to communicate and co-ordinate execution of the technology strategy and for prioritization of strategic actions.

Different types of alliances, coalitions and agreements form basic structures for strategic management of technology collaboration and networks which constitute of institutes, sub-contractors, suppliers, industry analysts, regulatory bodies, customers and even competitors. As a summary the suggested categorization for strategic structures is: processes, artefacts, methods and tools, organizational management functions, governance and collaboration networks.

Table 1: Structures elements of strategic management of technology framework

Structures of Strategic Management of Technology	
Artefacts	**Processes (continued)**
Technology strategy	Deployment
Technology forecasts, trajectories	Technology roadmapping
Technology map	Technology portfolio planning
Technology roadmap	Technology assets accounting
Architectures	Lifecycle planning
Architecture roadmaps	Technology insertion, refresh
Research portfolio	Technology retirement
Technology portfolio	Technology licencing
Technology portfolio development plan	Disposal
Technology portfolio deployment plan	End of life/disposal planning
Technology portfolio repository	**Tools, methods, IT systems**
Internal/external technical guidelines	Data management methods&tools
Internal/external technical standards	Knowledge manag. methods&tools
Supplier&collaborator base	Analysis&planning methods & tools
Processes	Engineering methods & tools
Technology strategy & planning	**Governance**
Technology outlook analysis	Decision making structure
Technology SWOT analysis	Decision making points
Technology planning	Decision making subjects
Identification	Decision making metrics
Technology scanning, scouting	Decision making criteria
Technology monitoring	Tech. guidelines governance
Technology intelligence	**Organizational management functions**
Technology forecasting	Technology management
Technology research	Tech. strategy management
Selection	Tech. planning management
Technology evaluation	Tech. portfolio management
Technology benchmarking	Tech. architecture management
Technology feasibility analysis	Tech. assets management
Tech. cost capability analysis	Tech. quideline/stds management
Technology performance analysis	Research management
Supplier evaluation	Product. dev. management
Supplier cost capability analysis	Tech. dev. management
Competitor analysis	IPR management
Acquisition	Standardization management
Due diligence,procurement	Supplier base management
Technology in-licencing	Collaboration management
Early supplier engagement	**Collaboration networks**
Technology creation	Research collaborators, institutes
Development	Technology collaborators
Technology improvement	Technology sub-contractors
Technology re-architecting	Standardization collaborators
Technology platform creation	Industry alliances
Protection	Strategic suppliers
Patenting, trademarks, copyrights	Competitors
License management	Customers
Encryption	Regulatory authorities
Standardization	Industry analysts

RESEARCH METHOD

Scope of the empirical research

Due to practical reasons, but compliant to requirements of qualitative research, the geographical scope is limited to enterprises having premises and personnel in Oulu region to ensure availability of interviewees and efficient use of research resources (see 27). Type of companies was not specifically limited to any industry. Most of the companies have global market, customers, competition and operations. Companies are designing, manufacturing and providing electronics, mechanical, medical instruments and software products, solutions and services. Decisive factor to involve a company in the research was interest and availability of company representatives for the interviews (see 27). Around 30 companies were contacted for asking their interest, and 22 interviews were carried through in companies in Oulu region in Finland.

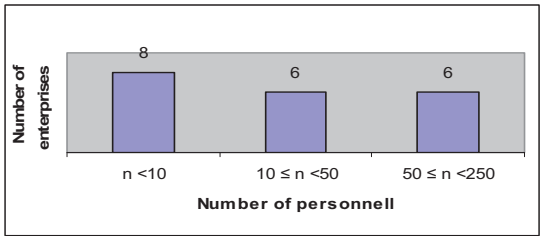
The informants for interviews were persons responsible on functions that are dealing with topics of technology management i.e. business, product, technology and R&D management, typically company founders and senior managers. The job titles of the 25 interviewed persons included CEO, COO, CTO, Site Manager, Engineering Manager, Director, Factory Director, Country Manager, Business Development Manager, Founder, Partner, SW Architect and Senior Specialist. Average working experience of the interviewees was over 15 years.

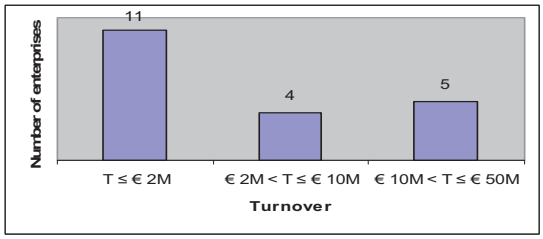
According to definition of commission of European Union in year 2005 (10), SMEs are classified as presented in the table 2. Based on the number of personnel and turnover of the interviewed companies, there are 6 medium-sized enterprises and 14 small enterprises participating in this research. By definition 8 of the companies are micro companies from personnel point of view and 11 according to turnover. Number of companies participating in this research as classified according to the number of personnel and turnover is presented in table 3. Eleven of the companies are less than 6 years old.

Table 2: Classification of Micro-, Small- and Medium-sized Enterprises in EU.

Classification	Number of personnel	AND	Turnover	OR	Balance sheet
Medium	< 250		≤ € 50M		≤ € 43M
Small	< 50		≤ € 10M		≤ € 10M
Micro	< 10		≤ € 2M		≤ € 2M

Table 3: Number of companies in the research as classified according to number of personnel and turnover.





Implementation of the research and evolvement of the theoretical framework

Research method for developing the framework is abductive in which the initial framework, derived from literature and practitioner workshop findings, describes the proposition which is expanded on and validated through results of subsequent research. The logic how empirical data is connected to the proposition is based on comparing and amending the developed initial framework with the analysis of the results of quantitative and qualitative research in SMEs. Thus information is gathered from multiple sources and inference is sought to find best possible description of the framework. It is expected that results support contents of the initial theoretical framework and increase its validity and enables generalization of the initial proposition.

The empirical research was conducted as interviews in 22 SME companies in Oulu region during November 2008. Two of the interview results were omitted from this analysis due number of personnel and turnover exceeding the definition of SME. The overview of the proceeding of the research and evolvement of the theoretical framework is presented in the figure 3. The initial framework was developed during year 2007 and early 2008, thus that research is not in the scope of this paper.

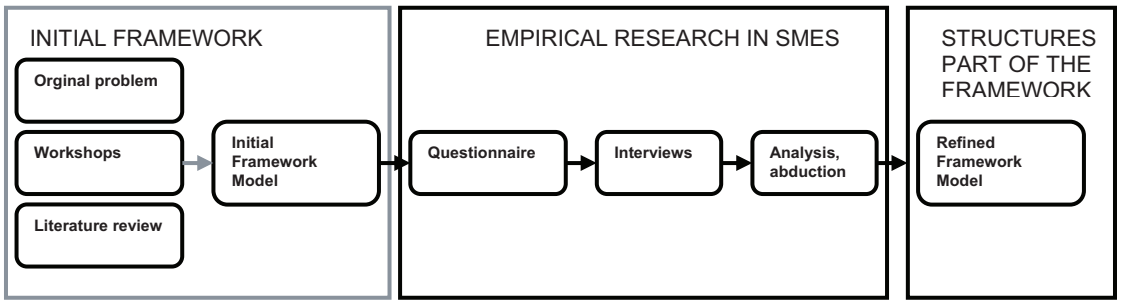


Figure 3: Proceeding of the research

The structural questionnaire consists of open qualitative questions and closed questions to be quantitatively evaluated by the interviewees during the interview. A pilot interview relieved that the number of questions were too extensive for conducting an interview within limited time. Thus in the final questionnaire the number of questions was reduced to 12 qualitative and 18 quantitative questions. Quantitative question evaluation scale was 1 to 5 to evaluate importance (not important, somewhat important, quite important, very important or extremely important) and current state (not practised, occasionally practised, developing practise, practised, well established practise) of the issue. Also the answering alternative “not applicable” was available. Open qualitative questions were asked first. The purpose of the questions was to elicit perceptions of the interviewees to management of technology in free form to avoid expression of preconception by researchers to the subject. Closed quantitative questions reflect to the elements of strategic management of technology framework, and they provide for interviewees a frame of reference to let the interviewees identify an element of management of technology, regardless whether it is familiar to the interviewee in advance or not. The interviews were recorded and lettered in the interview language that was Finnish. Lettered interviews were summarized and grouped according to interpreted similarities in answers to the quantitative questions.

PERCEPTION AND STATE OF THE PRACTISE OF MOT IN SMES

Perceptions of the interviewees on technology management are presented as condensed standpoints based on the qualitative questions of the interviews. All interviewees have their own viewpoint to Management of Technology (MoT) when asked using open questions. Many aspects are covered individually, but none of the respondents consider all of them. Quotations in the following are adapted from the interviews.

Definition and purpose of management of technology

"Management of technology is about knowing capabilities that technology provides for development of products, and about deploying technology for business."

Definition of Management of Technology is felt quite difficult as a comprehensive concept. It is understood to be an important base for products and product creation, and it is affected by the development stage of company and business environment in which the company operates. Starting point and purpose for MoT is fulfilling customer needs that lead into business opportunity and to identification, selection, acquisition or development of technology to be used in products. Essential is that right technologies are available for business goals, and that technology provides competitive advantage.

Management of technology is mostly seen as an implicit activity intertwining with company's business and product management and product development. Basis for MoT is assumed by the interviewees to be derived from company strategy and customer needs. Typically MoT is practised unconsciously and it is not systematically exercised. Thus knowledge of individuals on technology is utilized in defining company's business and product strategy especially at early stages of company development. Technology management is connected to follow-up of trends and to evaluation and selection of technology and platforms. Technology has to be positioned with regards to business and market development and technologies that competitors are using. Accordingly new possibilities need to be researched for creation of new products and improving competitiveness and performance of the existing ones. Scope of MoT is perceived to be people, knowledge, competence, acquiring best tools and methods, software, IT systems, architecture and products.

Key practices on management of technology

"You have to follow your time. People have built-in creativity and curiosity which need to be fostered through openness and trust in order to create innovations."

Key practises on management of technology are mentioned to be focusing on follow-up of trends and collecting information on new and available technologies. Most important sources for information are Internet, journals, news, fairs and people networks. Responsibility areas for technology follow-up are often defined for individuals, and product development people work together with product management and marketing to identify gaps and needs for technologies. Knowledge and competence of personnel is recognized to be important and being developed and maintained. Highlighted is also importance of fostering of innovative culture and open atmosphere of the company as means to manage technological and innovative capability of the company.

Feasibility studies and evaluations are made on identified promising technologies and trialled through prototyping, testing and piloting of products. Benchmarking and assessments are made to study performance and weaknesses of the products to find out improvement needs. Existing product platforms are utilized for development and verification of new products and

applications. Development of technology is mentioned as a systematic product development type of practise in a few companies. Platform decisions are also seen elementary for management of technology. Some of the companies make own research or are involved in research projects with suppliers and research institutes and universities. Also patent publications are followed to some extent.

The practises result in reports on competitor analysis, technology benchmarking and reviews, evaluation and testing. Also concept proposals and comprehensive technical and commercial study reports are mentioned by some of the interviewees. Other outcomes or documents mentioned being key to management of technology are company strategy, business and product plans, customer feature requests, product roadmaps, technology roadmaps, technology forecasts, lists of technology portfolio and links to information references in Internet. Many of the companies mention specifically that there are no systematic processes or formal practices defined for management of technology. Existing formal processes are typically identified to be related to quality management and product development and production. Road mapping is mentioned in a few companies. Some of the companies state that used technologies depend on diffusion of technologies used by end-users or industry standards and agreed policies state what technologies to use. Technology and platform decisions are mentioned to be documented as part of applicable management meeting minutes.

Decision making and governance of MoT

"Technology decisions are made as a part of leadership team work."

Decisions on technology are usually made on basic principles, guidelines and policies that are derived from business and product strategy. Decision making is influencing and related to all activities of the company, especially to products and applications development fulfilling customer needs. Planning of the technology management activities is happening as part of the business and product planning and budgeting, which may take place annually or when new opportunities or customer needs have been identified. In some cases company's vision, business strategy or explicit technology strategy is mentioned to set goals for technology management activities. New initiatives are handled and steered by leadership teams or in meetings where representatives of different functions are participating. Make, buy and collaboration decisions are made, as well decisions on what technologies are used for product creation. Decisions are concerned with product platforms, technology blocks, modules and components, interfaces, tools, methods, investments, costs, roadmaps and timing.

The bodies making decisions are often CEO or board of the company for major decisions. Various types of decision making bodies like leadership teams, product development management teams, steering teams and product council are mentioned. In some cases personnel is taking autonomous decisions on what technologies to use, and in some companies customers and even suppliers influence and steer technology selections. Decisions are made regularly when the above mentioned decision making bodies have their meetings i.e. annually, quarterly, bi-monthly, monthly, weekly or flexibly when necessary especially is small companies.

Objectives and impacts of MoT to competitiveness

"Customers expect usability, features and quality on our products. Objective is to make best commercial solutions based on available technologies."

Cleary technology have to satisfy customer and product requirements in terms of features, quality, usability, performance, reliability, security and energy efficiency, to name a few. Importance of complete solutions satisfying customer needs is also highlighted. Products are preferred to be based on open standards and have to comply with regulatory requirements and de facto conventions of the business area. A few companies seek for product differentiation, technology leadership or market leadership. Important is time to market and timing of product releases for example with respect to market seasons. Fundamentally availability of good enough technology is sufficient for most of the companies since differentiation comes through application of technologies to fulfil customer needs and through knowledge and expertise on customer's problems and processes.

Product cost and productivity enabled by right technology choices, tools and methods is emphasized. Also ability for flexible and adaptive production is mentioned, as well capability to enhance functionality and expansion of the products over the life-time. Right technology selections are seen as the most important to company's competitive advantages. Technology has to satisfy customer needs and to provide excellent productivity as effectiveness and efficiency in production and product development in terms of used technology, methods, tools and speed and flexibility to react on customer requirements.

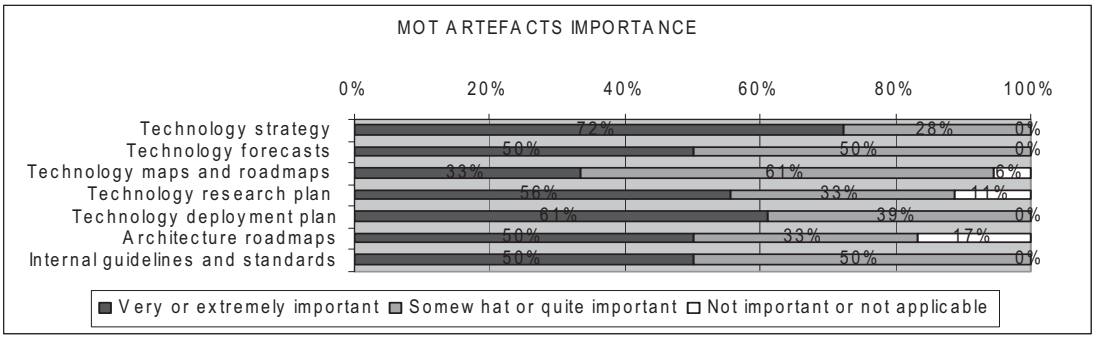
In order to make the right technology selections forecasting, assessment, evaluation and proof-of-concept methods are seen to have big impact on competitiveness. Also ability to identify new opportunities and areas for applications is noted. Improving capability of decision making based on formal data and with consideration of product life-cycle aspects is brought up. Companies also rely extensively on people's knowledge on technologies and on their inherent innovativeness.

Importance and current state of management of technology practises in SMEs

In the following in tables 4 to 7 is presented the frequencies of 18 company evaluations on importance and current state of management of technology artefacts and activities. Also a potential explanation to response patterns found form the results is given. Only frequency analysis is used due to relatively low number of companies evaluating the quantitative questions.

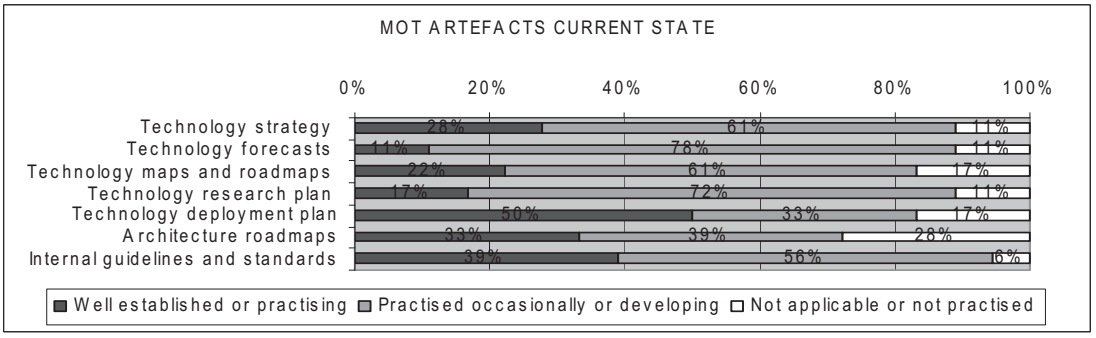
According to the evaluation results in table 4 all artefacts are seen at least somewhat important by over 80% of the companies. Technology strategy is seen as the most important artefact, which appears quite regular opinion for any company. Similarly technology deployment plan and internal guidelines seem to be normative for all companies. Importance of technology forecasts gets high evaluation, obviously due to the uncertainty of the business and technology environment. Technology maps and roadmaps are seen by 84% of interviewees important, but only one third see it very or extremely important. This seems to be related to the size and life-stage of the companies i.e. how many and for how long time products have been in the market. Typically larger and older companies see road mapping more important. Same applies for architecture roadmaps but three companies do not see it important or applicable at all. Two companies do not see research planning important or applicable for them because they are providing services or are in embryonic phase still. Technology research plan was seen important by all except two start-up phase companies.

Table 4: Importance of MoT artefacts



Although technology strategy is seen as the most important artefact, less than one third of the companies have technology strategy properly practised as presented in table 5. Only one company says it is well established, two companies say that they do not have technology strategy, the rest as a majority is developing the practise or have strategy occasionally existing. Best practised is technology deployment plan although only 50% evaluate that they do have a plan practised or well established. In SMEs internal guidelines and standards seem to be easy to agree as they are practised by 95% of the companies. Architecture roadmaps have most distribution in responses, about 1/3 has it practised, 1/3 is not practising and 1/3 is in between these ends. Only two (11%) of the companies say that they have technology forecasts properly practised which may indicate that forecasting is the most difficult activity to perform amongst day to day business practises. Technology maps and roadmaps are practised by one fifth of the companies, and three companies are not practising road mapping at all. This indicates that product and technology planning span is relatively short in SMEs. Technology research planning is practised by less than 20% of the companies which is also indicating short term product and business priorities in R&D activities.

Table 5: Current state of MoT artefacts



Distribution of the evaluated importance of activities is presented in table 6 and current state of the activities is presented in table 7. Highest ranking in evaluation of importance and current state of the activities are technology evaluation and linking technology plans with product plans, which is natural priority for a high-tech company. Companies also must concentrate on their own core, which is indicated by importance and current state of collaboration and supplier engagement, and can be seen as consequent importance of supplier and technology cost capability analysis. Another important activity is decision making on what technologies to use. One third of the companies evaluate that they are making systematic decisions on technologies and 90% is practising it at least occasionally.

Table 6: Importance of MoT activities

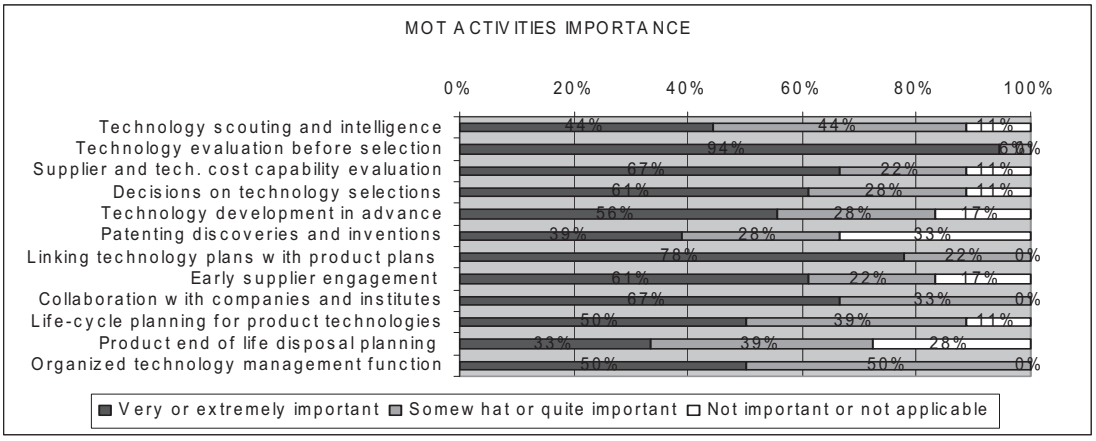
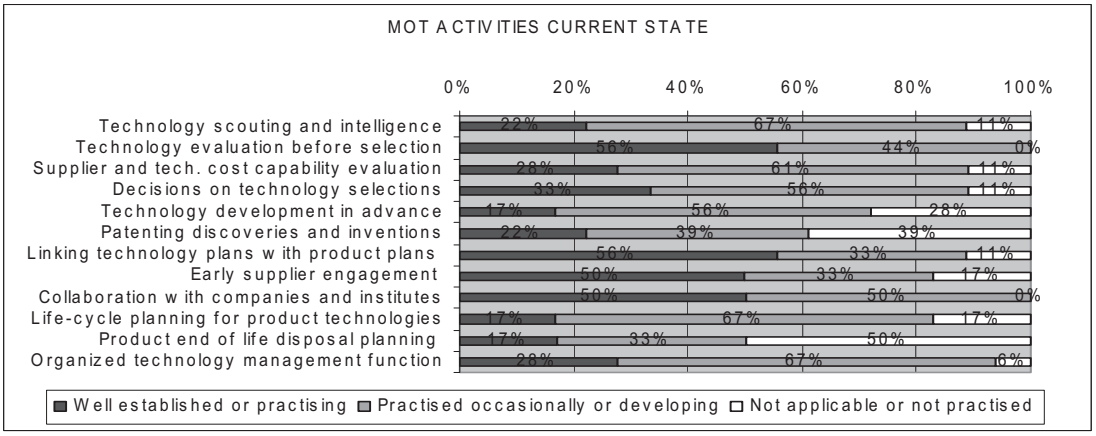


Table 7: Current state of MoT activities



Technology development in advance is seen quite or extremely important by majority of the companies, whereas less than half see technology intelligence that much important, which is reflected by low current state of these front-end activities. High-tech SMEs typically have focus on getting into market therefore product technology life-cycle planning and end of life disposal are seen very or extremely important by 50% and 33% of the companies, but practised only by 17% of the companies. One third of the companies do not see patenting applicable or important at all for them. Another 33% do see only some importance on patenting for them, whereas one third sees patenting extremely important. Based on interviews most SME companies do not have resources on expensive and time consuming patenting. Almost 40% of the companies are not doing patenting. Some do not see it necessary due to the business they are in. Although current state of practises is quite diverse all companies see organized technology management to have at least some importance for them, and all except one is practising it at least occasionally.

MANAGERIAL IMPLICATIONS

Management of technology is relative young discipline compared to strategic management, marketing and product management. Strategic management of technology has been researched by scholars increasingly some 30 years. Companies have converged since 1960's from single-function orientation to multifunctional strategic orientation due to continuing and

accelerating turbulence and complexity in the marketplace (2). In such business environment strategic management of technology is crucial for large and small companies to manage technology evolution and deployment as the essence of the company's capabilities and offering. Still management of technology is not clearly distinguishing as a function amongst other management disciplines.

The purpose of this study was to find out perceptions of management of technology and current state of practises in SMEs. Results and findings of the study confirmed that the field of MoT is complicated and somewhat confused among practitioners. From the responses it becomes clear that the companies have to prioritize activities which are securing short-term business goals, while hoping to have made right technology choices, and making the best out of the resources and available technologies. This is valid especially in the early stages in enterprise development when getting products to the market is the most critical activity.

Role of technology is seen as a key for effective product development and to knowledge on applying technology on customer's problems and processes. According to interviewees technologies have to offer right quality, performance and cost level of the developed products with right features over the product life-time. This imposes challenges to companies in terms of resource utilization for technology follow-up, evaluation, testing and technology development prior to product development. Right technology choices and availability of good enough technology is high-lighted, especially in the early stages in enterprise development when getting products to the market is the most critical activity.

Systematic decision making as an end to the means that MoT practises provide to fulfil customer needs and to reach enterprise business goals is crucial. Technology selections, tools and methods have major impact on company's internal processes and thus to productivity. The companies understand the role of platform selections and importance of technology selections to achieve business objectives. Used technologies are linked to product plans and before entry into the market, major challenge is to assess cost capability, maintenance and life-time costs of the selected technology for the company. Product disposal, end-of-life aspects and technology and product life-cycle planning are seen also challenging, although not being the first priority. Importance of managing life-cycles of products and technology is emphasized due to the need to identify technology risks early and due to the long-term impact on investments and on competitiveness that technology choices have.

Product and technology life-cycle management, technology scouting and road mapping are areas which are diversely practised. This may be due to the stage and sizes of the respondent companies i.e. young micro-companies do not pay much attention to anything else than making the fundamental business idea to succeed in the first place. In addition role of creating patents have diverse significance to the interviewed companies. Patenting is seen to be costly, time and resources consuming activity which has also been confirmed in research by Kitching and Blackburn (15).

Evaluation response frequencies to current state and importance of the practises indicate that MoT is seen important as a concept but in reality there is little evidence that practises are systematic or properly integrated into day to day operations. Berry and Taggart (3) state that formality increases along company's growth and development. It seems that medium-sized companies are more aware about the need for systematic MoT practises which may indicate

that they have to consider company's transformation from technology orientation to strategic or market orientation.

Regarding to the presented strategic management of technology framework the structures of the framework are in general recognized by the interviewees as important, but they are being practised variably in SMEs. From MoT generic processes point of view technology selection, development and protection are the most familiar activities, although also diversely practised. Technology management is governed and organized implicitly as part of other business management and product development management practises. Best practised areas are systematic technology evaluation before selection and objective of clearly defined product or services cost position. Also supplier engagement and collaboration networks are well identified and commonly practised i.e. companies have defined their core competence and technology, thus companies tend to have policies which parts of the products or activities are sourced or collaborated. Largest gaps are in technology strategy creation, forecasting, systematic decision making, life-cycle management and advance development. These all indicate lack of time and material resources to plan, research and develop technologies to be deployed in products.

Enterprises are not alike, but importance of strategic management of technology is uniformly similar for development of technological capabilities and sustained competitiveness in large and small companies. They all need to surmount within the same changing environment. Enterprises should look management of technology as a distinguishly organized and managed function that has interrelations to other functions and management disciplines in organization. A view to functional management of an enterprise is presented in figure 4.

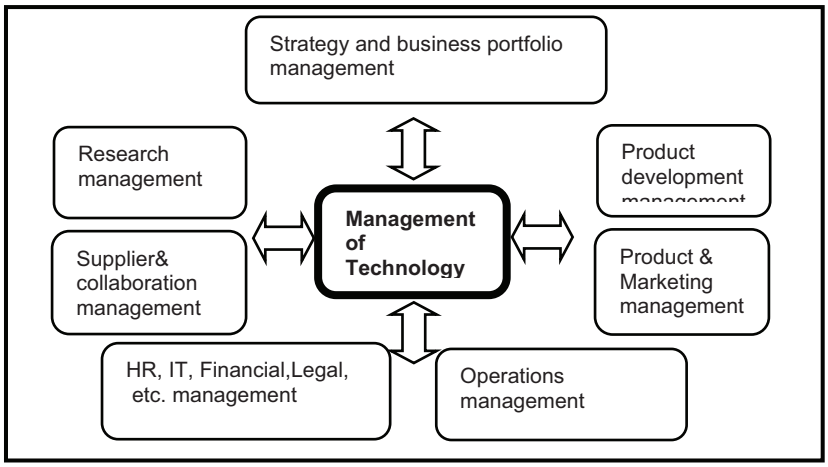


Figure 4: Functional management view to technology management in enterprise.

Strategic management of technology have implications to SMEs also especially on how to efficiently and effectively organize MoT activities i.e. what to do in practise and how, how systematic activities are, and how much resources are concretely allocated to the activities. SMEs do not have or need similar management practises or resources as large organizations (7, 23) and therefore MoT practises cannot be seen as downscaled from large enterprises. Another question is what management of technology activities to perform explicitly, what is done implicitly, and how to integrate those with company's decision making and other processes. All of the MoT practises involve specific skills and they need to be planned, organized, executed and monitored appropriately.

CONCLUSION

As a concise answer to the RQ1 and RQ2 it can be summarized that in the interviewed SMEs perception of the purpose and importance of management of technology is like-minded. Nevertheless every company have their specific problem areas due to the business and company life-stage, and they are struggling to formulate a comprehensive view and scope to management of technology. Currently management of technology is diversely practised as embedded activity integrated into company's business and product management and product development.

Characteristic for the companies participating in this study is that management of technology is contained in entrepreneurship as knowledge and experience of key individuals of the company, and that MoT is mostly practised implicitly. Starting point is to understand and predict customer needs and satisfying those as effectively and efficiently as possible within enterprise resources. Need for explicit technology strategy and systematic MoT practises become more evident as company grows, and consequently technology and management of technology becomes critical for the enterprise success. Aligned business and technology strategies are needed to enable communication and co-ordination of the execution of company's technology strategy through systematic technology management activities over the product life-cycle.

This research concentrated to find out perceptions on what is management of technology and importance and current state on what is practised. This study does not reveal on how practises are implemented and what is their maturity, effectiveness and efficiency, which all would be interesting for further study. Another area to study is methodologies and best practises across companies, evaluation of maturity of the practises and the impact of MoT to company's success and competitiveness. A problem is also how to organize and integrate MoT with company's other processes and management disciplines. All these topics would call for further research both in large and small enterprises.

Implementing management of technology knowingly for business benefits requires competence and rational effort. Intuitively companies may take the right steps, anyhow intensifying competition and pace of technological changes call for conscious improvement on management of technology practises in SMEs. As a whole there is still a lot of contingency in concepts and practises of strategic management of technology. Therefore consistent framework with clear definitions on elements of strategic management of technology is needed with insights and discussion of best practises to implement MoT in enterprises for sustained competitiveness.

Extend and need for systematic MoT practises change over time depending on the life stage and size of the company. As company matures and grows, management of technology practises can be assumed to develop accordingly through stages of initial, contingent, developed, advanced and established. In established stage practises are part of the organizational culture, and the scope and objectives of strategic management of technology is comprehensively understood. The proposed framework presented in this paper provides premise for theory development, and it is suggested to be applicable as a frame of reference for designing MoT practises in enterprises. As conclusion it is also suggested that strategic management of technology should be perceived and evolved in enterprises as a distinguishing

function and management discipline enhancing management paradigm of multifunctional strategic orientation.

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ON THE OPERATIONALIZATION OF STRATEGIC FRAMEWORKS: AN ANALYTIC NETWORK PROCESS (ANP) APPROACH TO PORTER'S FIVE FORCES MODEL

Mr. Hakyeon Lee, Seoul National University, Korea
yuny29@snu.ac.kr
Ms. Ran Kwak, Seoul National University, Korea
iris4@snu.ac.kr
Mr. Sanghoon Lee, Seoul National University, Korea
leessang83@snu.ac.kr
Dr. Moonsoo Kim, Hankuk University of Foreign Studies, Korea
kms@hufs.ac.kr
Dr. Yongtae Park, Seoul National University, Korea
parkyt@cybernet.snu.ac.kr

ABSTRACT

Porter's five forces model has been one of the most influential frameworks for strategic management. In contrast to its importance as a centerpiece of textbooks, however, it has attracted less attention from both academic researchers and practicing managers. This is due to its difficulty in operationalization. The vital requisites for operationalizing the five forces model are to deal with it as a complex system composed of interrelated forces and their sub-forces, and to prioritize them with consideration of their interdependency. This study proposes an analytic network process (ANP) approach to fulfill the requisites. The ANP, which is a generalization of the analytic hierarchy process (AHP), produces priorities of elements in a complex network model with consideration of interdependency among elements. The five forces model is transformed into a network model of the ANP. The ANP procedure is then carried out to obtain the priority weights of the forces. Combining the derived weights and ratings on the forces produces the state-of-industry-competition index (SICI) values that represent the overall competitive condition of a given industry. The proposed approach is expected to expand the five forces model into a workable system of analysis by improving its analytical power.

Keywords: Five forces model; Analytic network process; Competitive analysis; Strategic management.

INTRODUCTION

Porter (1980)'s five forces model has been one of the most influential frameworks for strategic management (Hax and Wilde II, 2001). It has been considered a standard tool for analyzing industry attractiveness, building upon the assumption that the state of competition in an industry is determined by the five competitive forces. In contrast to its importance as a centerpiece of textbooks on business strategy and strategic management, however, the five forces model has attracted less attention from both academic researchers and practicing managers (Grundy, 2006). The most plausible reason is due to its difficulty in operationalization; that is, its analytical power is limited in that the overall competitive condition as well as the degree of each force cannot be quantified. The vital requisites for operationalizing the five forces model are to deal with it as a complex system composed of interrelated forces and their sub-forces, and to prioritize them with consideration of their

interdependency.
The tenet of this study is the requisites can be achieved through the analytic network process (ANP). The ANP proposed by Saaty (1996) is a generalization of the analytic hierarchy process (AHP) which is one of the most widely used multiple criteria decision making method (MCDM). It produces priorities or relative importance of elements in a complex network model with consideration of interdependency among elements. Although the ANP was originally developed for selection and prioritization of alternatives as a MCDM method, it has widely been employed and proved to be effective for quantification of existing frameworks by prioritizing elements that are interrelated with each other such as balanced scorecard (BSC) (Leung et al., 2006), strategic management concept (SMC) (Asan and Soyer, 2008), and SWOT analysis (Yuksel and Dagdeviren, 2007). This study also proposes an ANP approach to operationalization of the five forces model.

The remainder of this paper is organized as follows. Section 2 briefly outlines the underlying methodology of this study, the ANP. The proposed approach is explained in Section 3. The paper ends with conclusions in Section 4.

ANALYTIC NETWORK PROCESS

The ANP is a generalization of the AHP (Saaty, 1996). The AHP, also developed by Saaty (1980), is one of the most widely used MCDM methods. The AHP decomposes a problem into several levels making up a hierarchy in which each decision element is considered to be independent. The ANP extends the AHP to problems with dependence and feedback. The ANP allows for more complex interrelationships among decision elements by replacing the hierarchy in the AHP with a network.

The process of the ANP is comprised of the following four major steps (Saaty, 1996; Lee et al., 2009).
(i) Step 1 (model construction): A problem is decomposed into a network in which nodes corresponds to components. The elements in a component can interact with some or all of the elements of another component. Also, relationships among elements in the same component can exist. These relationships are represented by arcs with directions.
(ii) Step 2 (pairwise comparisons and local priority vectors): The elements are compared pairwisely with respect to their impacts on other elements. The way of conducting pairwise comparisons and obtaining priority vectors is the same as in the AHP. The relative importance values are determined on a scale of 1–9, where a score of 1 indicates equal importance between the two elements and 9 represents the extreme importance of one element compared with the other one. A reciprocal value is assigned to the inverse comparison; that is, $a_{ji} = 1 / a_{ij}$ where a_{ij} denotes the importance of the ith element compared with the jth element. Also, $a_{ii} = 1$ is preserved in the pairwise comparison matrix. Then, the eigenvector method is employed to obtain the local priority vectors for each pairwise comparison matrix.
(iii) Step 3 (supermatrix formation and transformation): The local priority vectors are entered into the appropriate columns of a supermatrix, which is a partitioned matrix where each segment represents a relationship between two components. The supermatrix of a system of N components is denoted as the following:

$$
\mathbf{W} = \begin{array}{c|c|c|

The conceptual framework of the five forces model presented is transformed into a network model of the ANP in a way by which clusters in the network model corresponds to the five forces, and elements in a cluster are equivalent to sub-forces in a force. The interrelationships between forces are represented by arcs with directions. Since the interdependencies among forces are implicitly only given in Porter's original work and other textbooks, they have been defined based on the previous studies explicitly specifying them (Chen et al., 2001; Grundy, 2006).

Figure 1 shows the constructed ANP network of the five forces model. The detailed descriptions of the sub-forces are summarized in Table 1 with their abbreviations and types. Some of the sub-forces give a rise to the intensity of competition when the degree is high while the others do when they are low. The formers are classified as positive (+), and the latter is denoted as negative (-).

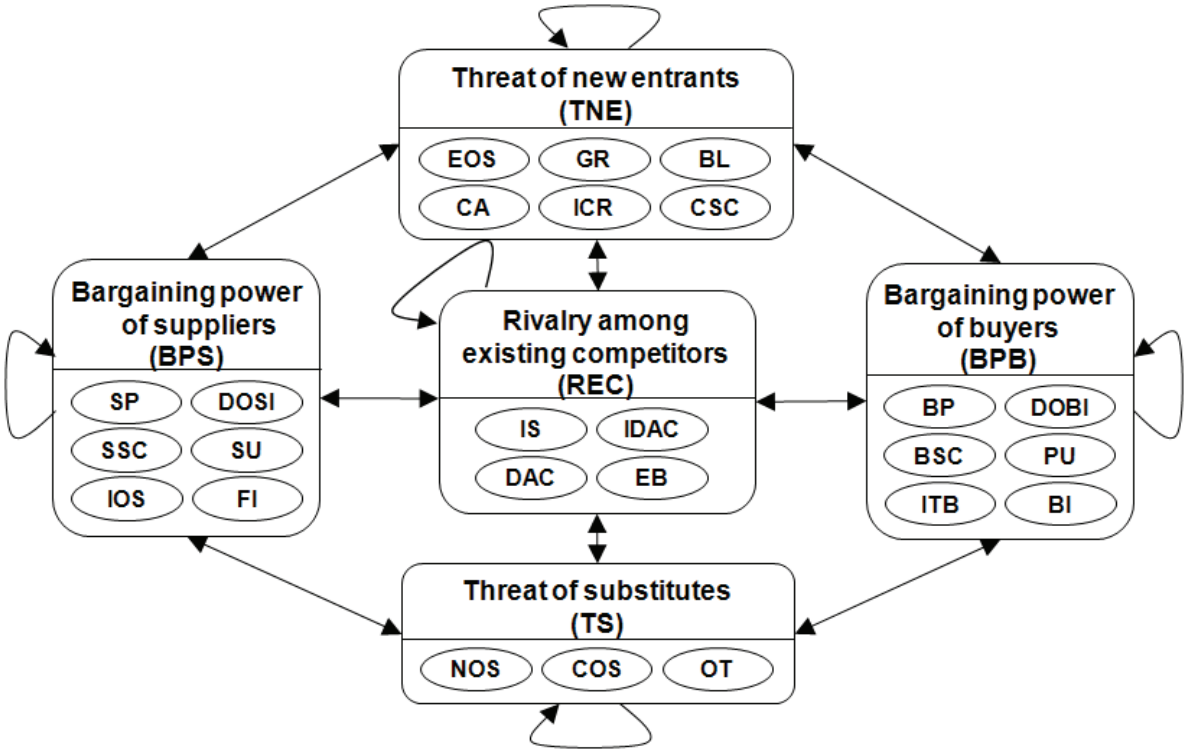

Figure 1. The ANP network of the five forces model

Table 1. Forces and sub-forces

Forces	Sub-forces	+/-
Threat of new entrants (TNE)	Economies of scale (EOS)	-
	Government regulation (GR)	-
	Brand loyalty (BL)	-
	Cost advantages (CA)	-
	Initial capital requirement (ICR)	-
	Customer switching costs (CSC)	-
Bargaining power of suppliers (BPS)	Supplier portfolio (SP)	+
	Dependence on supplier industry (DOSI)	+
	Supplier switching costs (SSC)	+
	Supplier uniqueness (SU)	+

	Importance of suppliers (IOS)	+
	Forward integration (FI)	+
Bargaining power of buyers (BPB)	Supplier portfolio (SP)	+
	Dependence on supplier industry (DOSI)	+
	Supplier switching costs (SSC)	+
	Supplier uniqueness (SU)	+
	Importance of suppliers (IOS)	+
	Forward integration (FI)	+
Threat of substitutes (TS)	Number of substitutes (NOS)	+
	Closeness of substitutes (COS)	+
	Other technologies (OT)	+
Rivalry among existing competitors (REC)	Industry structure (IS)	+
	Industry demand and capacity (IDAC)	+
	Differentiation among companies (DAC)	-
	Exit barriers (EB)	+

Procedure

The proposed approach consists of the three stages. Figure 2 shows the overall procedure of the proposed approach.

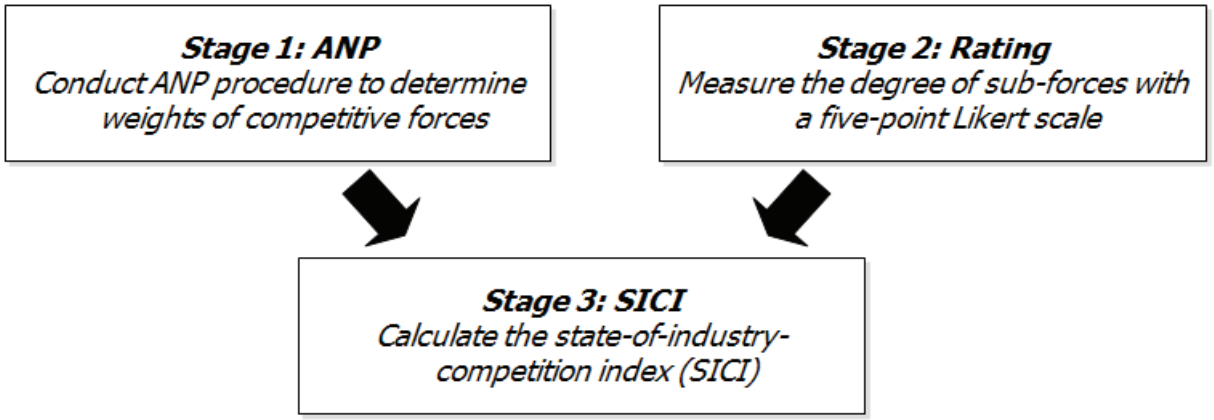

Figure 2. Overall procedure of the proposed approach

Firstly, the ANP procedure is then conducted to produce priority weights of the forces and sub-force at Stage 1. Pairwise comparisons are made among the forces and sub-forces based on their interrelationships. The supermatrix is constructed with the local priority vectors obtained from pairwise comparisons. The corresponding form of the supermatrix to the network model in Figure 2 is as the following:

$$\mathbf{W} = \begin{array}{c} \\ \\ C_1 \\ \\ \vdots \\ \\ C_k \\ \\ \vdots \\ \\ C_N \\ \\ \end{array} \begin{array}{c} \begin{array}{cccccc} C_1 & & \cdots & C_k & & \cdots \end{array} \quad C_N \\ \begin{array}{cccccc} e_{11}\cdots e_{1n_1} & & \cdots & e_{k1}\cdots e_{kn_k} & & \cdots \end{array} \quad e_{N1}\cdots e_{Nn_N} \\ \begin{array}{c} e_{11} \\ \vdots \\ e_{1n_1} \end{array} \\ \begin{array}{c} \vdots \\ e_{k1} \\ \vdots \\ e_{kn_k} \end{array} \\ \begin{array}{c} \vdots \\ e_{N1} \\ \vdots \\ e_{Nn_N} \end{array} \end{array} \begin{pmatrix} \mathbf{W}_{11} & \cdots & \mathbf{W}_{1k} & \cdots & \mathbf{W}_{1N} \\ \vdots & & \vdots & \ddots & \vdots \\ \mathbf{W}_{k1} & \cdots & \mathbf{W}_{kk} & \cdots & \mathbf{W}_{kN} \\ \vdots & & \vdots & \ddots & \vdots \\ \mathbf{W}_{N1} & \cdots & \mathbf{W}_{Nk} & \cdots & \mathbf{W}_{NN} \end{pmatrix}$$

The supermatrix is then transformed into the weighted supermatrix and the limit supermatrix. The converged column of the limit supermatrix contains global priority weights of each sub-force.

In stage 2, industry experts give ratings on the degree of the sub-forces with a five-point Likert scale from 1 (very low) to 7 (very high). In the case of negative items, the reverse value is assigned for measurement to be consistent.

Stage 3 measures the state-of-industry-competition index (SICI). It is calculated as the weighted sum of global priority weights of the sub-forces and corresponding ratings:

$$SICI = \sum_{k=1}^{5} \sum_{j=1}^{n_k} w_{kj}^{g} r_{kj}$$

where n_k is the number of elements in the kth cluster, w_{kj}^{g} is global weight of the jth element of the kth cluster, and r_{kj} is the rating on the jth element of the kth cluster. The SICI represents the overall competitive condition of an industry. The higher the value of SICI, the more intense the industry competition and the less attractive the industry. The SICI of each force can also be obtained by using the local weights normalized by each cluster. It is defined as the following:

$$SICI_k = \sum_{j=1}^{n_k} w_{kj}^{l} r_{kj}$$

where w_{kj}^{l} is the local weight of the jth element of the kth cluster. The pattern of changes in the competitive condition of an industry can be observed by conducting the same analysis for multiple time points. Figure 2 shows an example of the final output of analysis, competitive dynamics of an industry.

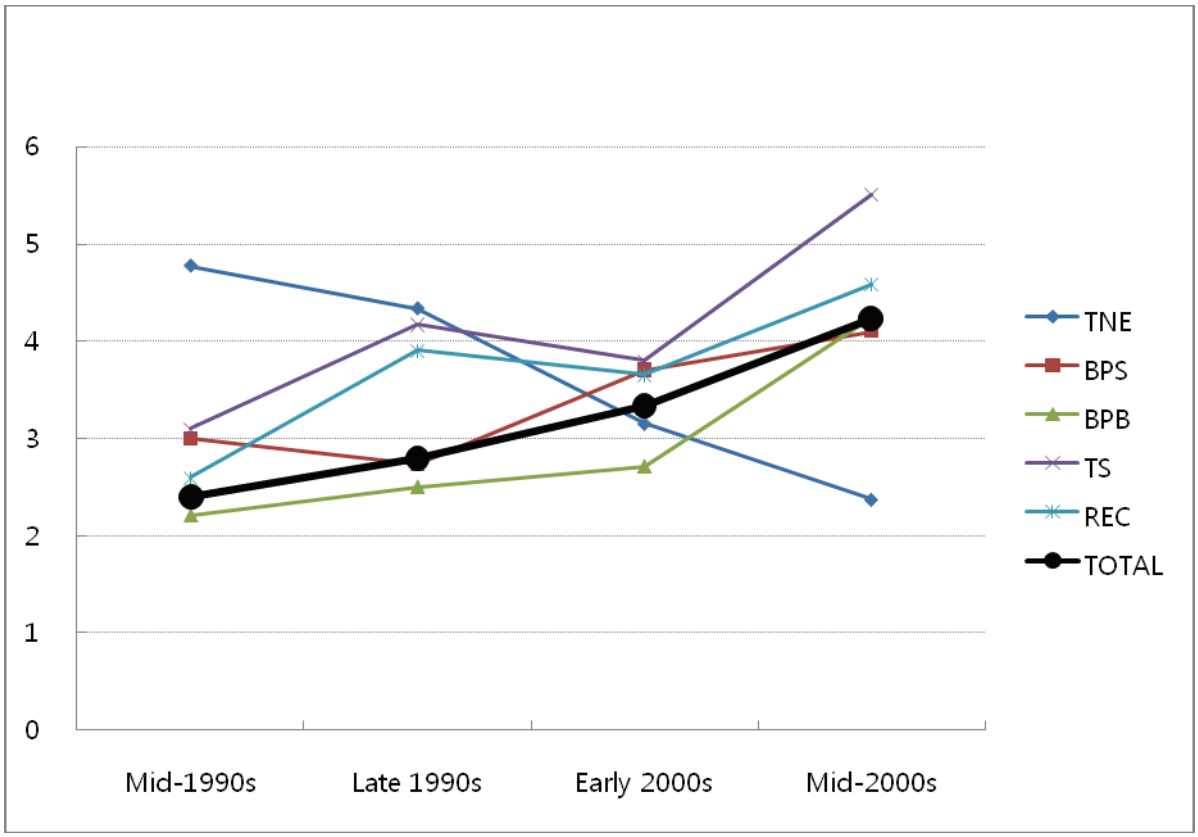

Figure 2. Changes in SICI

CONCLUSIONS

This study proposed an ANP approach to operationalization of the five forces model. The five forces model was transformed into a network model of the ANP. The ANP procedure was then carried out to obtain the priority weights of the sub-forces. Combining the derived weights and ratings on the sub-forces produces the SICI values that represent the overall competitive condition of a given industry.

Since the ANP produces priorities of elements in a complex network model with consideration of interdependency among elements, it can fulfill the requisites for operationalization of the five forces model, prioritization of the forces with consideration of their interdependency. The proposed approach is expected to expand the five forces model into a workable system of analysis by improving its analytical power.

The clusters and elements of the ANP model are by no means exhaustive or fixed. Although the model was constructed based on the Porter's original work, it can be variant depending on the industry or strategic context. The irrelevant sub-forces can be ignored, and additional sub-forces considered important can be added. The sixth forces such as complementers (Hill & Jones, 2004) and government regulations (Rugman & Verbeke, 2000) can also be included in the model. The major task to be conducted in future research is to apply the proposed ANP approach to a real case.

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A NEW MODEL FOR MANAGERS USED FOR POSITIONING THEIR ORGANIZATIONS IN MARKET PLACE

Ahmadreza Shekarchizadeh, University Technology Malaysia, Malaysia
Ahmad_shekar2@hotmail.com

ABSTRACT

Diagnosing position of an organization for top managers in the competitive environment is vital for making strategies to grow firm. The purpose of this paper is finding a model for managers to diagnose position of their organization in the market place. Managers usually are too busy to study complicated strategic models, so the aim of this paper is offering a model without usual complexity for top managers. Top manager who uses this model is like the captain who uses his map to realize his situation and the rout to his destination.

Keywords: marketing, quality, position

INTRODUCTION

The variety of firms in the service industry makes generality regarding strategy difficult. A scheme is presented to classify service organizations in a way that provide strategic insight and transcend narrow industry boundaries. This scheme can be used to think about the choices being made to position the service in relation to its competitors. According to (Fitzsimmons & Fitzsimmons, 1994), Positioning is a marketing term used to describe the process of establishing and maintaining a unique place in the market.

A BRIEF HISTORY

After reviewing the literature, author realized that there isn't a model without usual complications for managers in order to position their organization in market place. One of the most well known classification schemes developed by Christopher Lovelock (C. H. Lovelock, 1983) that are regarding possible strategic dimensions which transcend industry boundaries. He has classified the services for strategic insights referring nature of the service act, relationship with customers, customization and judgment, nature of demand and supply, and method of service delivery. In the following, the first one has been explained.

The service act can be deliberate across two dimensions: extent of tangibility nature of the service and who or what is the direct receiver of the service (Figure 1). Accordingly services can be classified to four classes: (1) tangible actions directed to the customer, for instance restaurants and hospitals; (2) tangible actions directed to the customer's possessions, for instance laundry and industrial equipment repair; (3)intangible actions directed at the customer mentality, such as museums and cinemas; and(4) intangible actions acted on customer's assets, for instance accounting.

Nature of the Service	Direct Recipient of the Service: People	Direct Recipient of the Service: Things
Tangible actions	*Services directed at peoples bodies*: Passenger transportation ▪ Health care ▪ Exercise clinics ▪ Haircutting	*Services directed at goods and other Physical possessions:* ▪ Laundry and dry cleaning ▪ Freight transportation ▪ Veterinary care
Intangible actions	*Services directed at people's minds:* ▪ Education ▪ Broadcasting ▪ Theaters	*Services directed at intangible assets:* ▪ Accounting ▪ Securities ▪ Banking

Figure 1: Lovelock (1983)

Next, (Chase & Hayes, Fall, 1991) proposed an operations-oriented framework. By this framework, service performers are grouped into four levels: loser, nonentity, professional, and leader.

The model that will be discussed is a new one which has based on the satisfaction literature in marketing. This model tries to classify organizations based on their performance. One of the most important advantages of this model is its implications in the field of marketing, operations, and human resources. With using this model, organizations can be classified to four categories. In the other words, this model is a grid for managers to diagnose weaknesses and strengths of their organization.

A NEW MODEL

After measuring perception and expectation of customer in the field of dimensions of quality in organization, managers could calculate mean of them. Mean of the dimensions (for example, according to items of SERVQUAL model offered by (Parasuraman, Zeithaml, & Berry, 1988b)for perception and expectation, indicate in which position organization will be. Chart 1 shows this model. There are four positions:

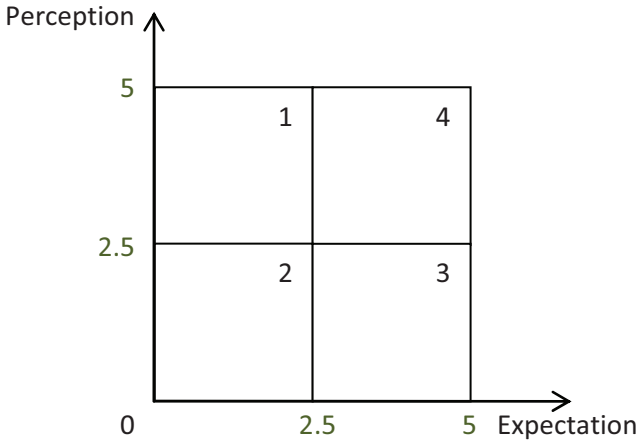

Chart 1: A model for classification of organizations

1. 2.5< Perception < 5
0< Expectation < 2.5 ⇒ Position 1

Organizations in position 1, perception of their customer is much more from their expectations.

- **Marketing Function specifications**: These organizations raise customer expectations to new levels and continuously improve their quality. Also, these organizations usually are leader in their industry. According to Chase and Hayes in (C. Lovelock, Wirtz, & Chew, 2008), these are main leader in special segments, recognized for marketing skills; brand name of their services; conduct sophisticated analysis of relational databases as inputs to one-to-one marketing and proactive account management. From competitive appeal point of view, company's name is synonymous with service excellence; its ability to delight customers raises expectations to levels that competitors can't meet. Concept testing, observation, and contacts with lead customers are used in the development of new services that respond to previously unrecognized needs.

Furthermore, from competition perspective firm is well known for its service excellence. In these organizations, customers usually are delighted by delight programs that usually competitors couldn't offer. According to (Rust & Oliver, 2000), delight programs are probable to be profitable if customer satisfaction can be maintained at the higher expectation levels caused by assimilated levels of delight. This is true both for the firm's customers and those converted from competitors. Moreover, satisfaction with higher levels of quality as perceived by current customers will attract more customers from other firms as a result of decreasing level of satisfaction with the competitors' lower quality. Another distinctive of these companies is their selected customers. Customers are selected and preserved based on

their potential value to the firm, including their potential for new service occasions and their capability to inspire novelty.

- **Operation Function specifications**: They use progressive techniques; use theory testing; use of head customers as inputs to new-service growth and have enlightened Customer Relationship Management (CRM) systems. Business experts work with technology leaders around the world to expand new applications that will create a first mover advantage. Consequently, the company can achieve at levels that competitors cannot hope to attain for a long time.
- **Human Resources Function specifications**: Clear standard processes in the organization help employees to follow them, and this facilitates the work of them. Top management consider quality of their employees as an important competitive advantage. There is a culture of service-oriented in the firm that has developed by human resource managers, who create a superior working environment that attracts and retain the best people. The stuff are committed in the firm's values and aims. Employees propose new ideas because they are involved, empowered and quick to adapt change.

2. $0 < \text{Perception} < 2.5$
$0 < \text{Expectation} < 2.5$ ⇒ Position 2

- **Marketing Function specifications**: Organizations in position 2, meet some customer expectations and are consistent on one or two key dimensions, however they fail to be reliable in all dimensions. According to Chase and Hayes in (C. Lovelock et al., 2008), these organizations uses mix of selling and mass communication, using simple segmentation strategy and make selective use of price discounts and promotions. They might use price discounts to try to attract new customers. Also, these institutions usually conduct and tabulate basic satisfaction surveys. Customers usually neither seek nor avoid the firm. Managers may talk about improving quality and other aims, however they fail to set clear priorities, to have a clear direction, nor gain the respect and commitment of their employees.
- **Operation Function specifications**: From perspective of management function in principal line, they create and deliver service, focuses on standardization as key to productivity. Quality in these institutions is defined from internal perspective. Also they run each step in delivery service independently. One of their main weaknesses is that support stuff is unfamiliar with customers. They also reward for keeping costs below budget and stick to traditions.
- **Human Resources Function specifications**: Their policy for human resources is recruiting and training employees who can perform competently. Workers follow

procedure but aren't motivated and turnover usually is high. Managers in front line control workers.

In these organizations, although there are a lot of rooms for improvement, their position is better of organization in location 3, that have the worst features. A few organizations may compete in this way and it is difficult to tell one from the other.

3. 0 < Perception < 2.5

2.5 < Expectation < 5

- **Marketing Function specifications**: These firms are at the bottom. They are unsuccessful in marketing, operations, and human resource management. They are highly variable from service quality perspective, usually unsatisfactory. These firms are subservient to operations priorities. According to Chase and Hayes in (C. Lovelock et al., 2008), role of marketing managers is limited to tactical role. In addition, advertising and promotions lack focus and no involvement in product or pricing decision. Also role of frontline managers is limited to control workers.

Customers utilize these firms for reasons other than performance. These firms have unspecified customers and serve a mass market at a minimum cost. Customers buy from them because there is usually no other option. This is the reason why these companies continue to survive.

- **Operation Function specifications**: Operations in these organizations are reactive and cost oriented. Also, locations and schedules are unrelated to preferences of customers, who their needs usually are ignored. Backstage operations are separately from front-stage and productivity is usually undefined. In this direction, managers are punished for failing to bond within budget.

According to Rogers in (Rasli, Arshad, Talib, Ramli, & Senin, 2008), stages in the technology life-cycled can be identified based on the relative percentage of customers, to five stages. The organizations in position three are at last stage in Rogers model, who are late adopter and Rogers identified them as Laggards. They use new technology when it is necessary for survival.

- **Human Resources Function specifications**: From human resource point of view, these organizations are involved in the employee cycle of failure and customer cycle of failure(C. Lovelock et al., 2008). The employee cycle of failure begins with a tight design of jobs for low skill levels. There is an emphasis on rules rather than delivering service, and the use of technology to control quality. Management supplies low-cost employee who meet minimum skill requirements for the job. Employees are not interest, have negative constraint, poor performance, disloyal and do not care. Accordingly, they lack the ability to respond to customer

problems. Then they become dissatisfied and expand a poor service attitude. This result for the organization low service quality and high employee turnover. Because of low profit margins, the cycle repeats itself with the hiring of more low-paid employees to work in the same manner. Some service organizations can reach such low levels of staff drive that frontline workers engage in service damage rather than deliver service excellent.

The customer cycle of failure begins with emphasizing on attracting new customers. Because employees are dissatisfied, the customers become dissatisfied with employee performance. High employee turnover means that consumers are always served by new faces, so there is no continuity. This in turn causes customers fail to be loyal to the firm. This cycle repeat it by requiring firm an ongoing search for new customers to maintain sales volume.

4. 2.5 < Perception < 5
2.5 < Expectation < 5 → Position 4

- **Marketing Function specifications**: These organizations consistently meet or exceed customer expectations across multiple dimensions. According to Chase and Robert (C. Lovelock et al., 2008), these organizations have clear positioning strategy against competition, use focused communications with distinctive appeals to clarify promises and educate customers. Their policy for pricing is based on value, and they monitor customer usage and operate loyalty programs. Furthermore, they use a variety of research techniques to measure customer satisfaction and obtain ideas for service enhancements. Marketing managers work with operations to introduce new delivery systems. Customers look for the firm, based on its continued character for meeting customer expectations.
- **Operation Function specifications**: In these organizations operations have a strategic role in competitive strategy. Operations managers recognize tradeoff between productivity and quality. Operations and marketing managers' work together to introduce new delivery systems. Also they willing to outsource and monitor competing operations for ideas or threats. Service delivery in front line is driven by customer satisfaction, not tradition. Front line always willing to customize, accept new approaches and emphasis on promptness, convenience and comfortable.

From point of view supporting operations, there are clear links between backstage and front line activities. Also they consider their role as serving internal customer, who in turn serves external customers. Top managers in these organizations focus on reengineering backstage processes and avoid productivity improvement that will degrade customers' service experience. Additionally they continually refine processes for efficiency. According to (Rogers, 1995), when a new technology is created, these organizations are early adopters, who are primarily concerned with the underlying technology and its performance. Especially,

when IT promises to enhance service for customers and provides a competitive edge, these organizations quickly approve it.

- **Human Resources Function specifications**: Human resource managers in these organizations, invest in selective recruiting, ongoing training. They also keep close relationships to employees, promote upward mobility and try to enhance quality of working life. Consequently, employees are motivated, hard working, and allowed some discretion in choice of procedures. Top managers usually encourage staff to recommend, hence workforce offers many suggestions. Frontline managers listen to customers, coach and facilitate workers.

CONCLUSION

A new classification of organizations presented in this article, provides a tool for managers to understand position of their organization and lead their firms in order to grow up levels of service performance. This model also has implications from perspectives of marketing, operations and human resources. Managers in organizations should try to shift their organization to position 1.

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THE ROLE OF HUMAN RESOURCES MANAGEMENT AS A STRATEGIC PARTNER

Ravee Phoewhawm, Chiang Mai University, Thailand
rtcm999@yahoo.com

ABSTRACT

The human resources management profession is under pressure from their C.E.O's to bring more value for their organization. Professor David Ulrich, of Michigan University, has done extensive work on trying to make Human Resources Management (HRM) a strategic partner. Despite providing good theoretical concepts most of the profession has been viewed in the eyes of their organization as being neither strategic nor adding much value for their organization. This study focuses on converting this line of work from an administrative position into a strategic role. The work is aimed at gaining insight on the attitude and working behavior to see what is the cause that is preventing or failing to make HRM on becoming a strategic partner. Five open-ended questions were constructed to ask human resources manager working at manufacturing industry and regular workers from other fields for data collection. The findings revealed that HRM has inserted itself into a position for ensuring that all of the energies, behaviors, and efforts of the workers comply to the operational output with efficiency. Workers in general see the profession of HRM providing very little positive impact to their organization. Some knowledge management theories have been proposed as a rational guideline for making the human resources profession mindset to assume the strategic role.

Keywords: systems thinking, decision-making, customer focus, human resources strategy.

INTRODUCTION

With globalization causing an unpredictable and rippling effect in the economic cycle of the world it's time for the staff and title holders of human resources management to heed to the signals and take proactive measures in order to justify their position within their own organization. Scholarly literature and strong requests from chief executive officers for making HR a strategic partner cannot be taken with a lukewarm reception. For the HR profession in this age knowing what to do does not transmit enough credibility when the demand is asking for knowing how to do it. The former task performs within the system while the latter is based on producing values and benefits for the organization. Ever since Professor David Ulrich, from the University of Michigan, sent out the message to the world of Human Resources Management on becoming more of a business partner there has been many ideas and interesting models for the practitioners of HR to follow. Professor Ulrich (1997) has stressed that:

- the HR function needs to become **strategically proactive**,
- that HR needs to go **beyond administrative expertise** and

- ☐ be an **expert in strategic business partnership, change management, and employee advocacy**.

Despite the urge and scholarly effort by Ulrich for HR to modernize its position, there has been a lack of initiative to do so. Works gathered from other profession studies reveal the information as followed:

1. HR's working relationship with their line managers tend to be emphasized on the rules and policies over the final production. This leads to HR and the line managers always being in a state of disagreement. (*Workforce,* August 1999, Vol. 78., No. 8, pp. 32-38.)

2. The Chief Executive Officers see their HR people focusing only on their general function to fulfill the quantitative assignments. Hiring a certain number of new staff in order to fill the quota is a good example. HR's concentration on their functions makes their C.E.Os believe that HR is unresponsive to the rapid changes in the business world. (*Joe Wert,* Copyright 2002 The Segal Company (Eastern States), Inc.)

3. When it comes to business goals, HR remains conservative while other business units have taken a strategic role during the period of business turbulence. It just seems that they are unwilling to learn in making their business grow. (*Workforce,* January 2003, pp. 26-30 By Shari Caudron)

4. The HR staff themselves execute on familiar tasks and duties that complies to the basic administration of human resources management. This clearly shows that they are failing to convince top management of becoming a strategic business partner. (Lawler, Edward E., Mohrman, Susan A. Human Resource Planning • Sept, 2003)

David Ulrich proposed four role models (2005) for HR. This contributed to the movement of HR from a functional orientated standpoint to a more partnership-centered one for their organization. Ulrich defines the recommended roles as followed:

Proposed Role	**Characterization**
Strategic Partner	Alignment of human resources activities and initiatives with the global business strategy.
Change Agent	Supporting the change and transition of the business in the area of the human capital in the organization.
Employee Champion	Attending to the interest of employees and installing confidence during the process of the change in the organization.
Administrative Expert	Searching for an opportunity of providing quality service with efficiency for the organization.

However, the progress for HR has been limited. According to Kiger, only 23% of the HR departments have taken part in corporate strategy and made a significant impact on operating results. *(Patrick J. Kiger, May 29, 2007)* Overall, HR departments are still not considered a valuable strategic asset. The findings by Suri (Nishchae Suri, Business Head,

Consulting Analytics, Asia-Pacific, Hewitt Associates 2008) states that the majority of HR executives remain, to all extent and purposes, neither strategic nor leaders.

This paper is aimed at leading HR to take a mental approach into becoming a strategic business partner to their organization. So much work and seminar have been constructed to actually make HR go beyond their role. The so called knowledge economy has called for HR to assume the leading role in bringing out the best in talent, expertise, performance, and intelligence for making their organizations highly competitive. The workshops and educational documents from the HR gurus and mavens may have entertained the sight and sound of these professional. But in the end, the thoughts and behavior have portrayed the opposite direction in being a strategic partner. The question raised is "*What are the obstacles that are preventing HR from becoming a strategic partner?"* Therefore, this paper offers a new point of method for HR to become this idealistic role. The new way is targeted at the mind of HR. It is the belief that the frame of mind is the potential weapon that can either help HR advance or decline in their quest to become that valuable cohort. By changing the mind, the attitude and behavior will follow with the changes. The driving force for this study stems from the opportunity to revamp the image of HR to be more devoted to the human side.

The structure of the paper is outline in the following. First, strategic theories and approaches have been analyzed for literary discussion to see if there is crucial information that leads to a path for HR in taking on strategic role. Second, the answers to the research question on "*What are the obstacles that are preventing HR from becoming a strategic partner"* have been provided by analyzing the data collected. For the third part, an approach using Peter Senge's "systems thinking" as a knowledge management tool along with business case studies and professional analogy have been designed as the framework for HR to inherit a new outlook. In theory, it is hope that this will serve as the basis for HR to finally see that they actually can become a strategic partner after all.

1. Literature Review.

Aughton (2005) suggests that HR needs to frame a new mental model that will make others take notice and listen to the profound and sustainable benefits HR brings to organisations in the new economy. Such a mental model must form the strategic framework that provides HR professionals with the evidence that HR is truly adding value to key stakeholders. Aughton tells us that "as societies shift from the old industrial era to new service/knowledge economies the more valuable HR deliverables will become in creating a competitive advantage for organizations. He claims that the market values of companies that are largely determined by the intangibles; if they're not managed properly they can have a negative impact on the shareholders' value. Aughton points out to how intangibles such as leadership, governance, R&D, innovation, reputation, brand strength, tacit knowledge, plant flexibility, speed and quality of service, customer and employee loyalty, and informal processes and trusted networks are the essential factors that build the future growth expectation of investors. What's really good for HR is that, as Aughton describes, it presents tremendous opportunities for this type of profession because the only way these intangibles can be achieved is through people. Since HR deals with people, the new mental model that Aughton proposed is to think systematically. Aughton advises HR to mind-frame their organization operating within its environment and to be a competent in using state-of-the-art systematic tools and concepts designed for adding value to stakeholders. He feels that this idea will enable HR to see their organization from a different view. This will lead HR to act

on the important strategic business matters that other managers might have overlooked. While Aughton recommends this mental model it doesn't quite strike up the nerve for HR to make this proactive movement.

Price (2008) cites work from other studies on making HR positioned in a strategic role. Price reports on Gubman's 'HR Strategy and Planning: From Birth to Business Results' study of having the focus as their financial colleagues: return and growth. Therefore, 'HR-things' can only create economic value from three sources:

- Employee turnover and retention
- Productivity - revenue against employee costs
- Expenditure on the HR function and related activities

Price also informs that this work by Gubman relates to three familiar HR goals:

1. Attracting, developing and retaining staff
2. Aligning, engaging, measuring and rewarding performance
3. Controlling or reducing HR costs

Price then alludes to the study done by Tamkin who used a set of criteria described as the '4A model' (Access, Ability, Attitudes, Application). From the study of almost 3000 British organizations, it was discovered that the use of 'bundles' of HR practices produced improved performance and profitability. A number of issues were suggested for HR managers to focus on:

- Access The quality of the recruitment process: putting serious effort into attracting high quality applicants; using policies and practices that 'ensures the ongoing movement of the best people through the organization'.
- Ability Effective, long-term development plans focused on the needs of employees and the business. These plans should be constantly monitored to ensure their effectiveness. The researchers also highlight the need for a high workforce quality, e.g. possession of degrees.
- Attitudes Aligning employees to the objectives of the organization - 'vital in terms of capturing discretionary effort'. They emphasize one-to-ones, appraisals and reward strategies related to organizational performance.
- Application Encouraging autonomy, empowerment and generation of ideas.

And finally, Price refers to Weiss's argument that HR managers must demonstrate the ability to provide stimulating ideas and challenge decisions that do not have business value. Most importantly, they need to wear a 'business hat' rather than a 'HR hat' otherwise they will be relegated to the traditional administrative or tactical (second-level) role that has be-devilled the human resource function for decades. Weiss considers that HR managers need to demonstrate the following to show their ability to add value:

- Broad understanding of the business, thus helping the human resource function to contribute to the overall direction of the company.
- Knowledge of how all activities needs to be aligned, thus enabling the company to maximize the success of its strategic initiatives.

- Professionalism in investing in human capital and HR processes, allowing HR to help guide employees and the organization's decision making.
- A unique perspective, allowing the HR function to become an 'ideas merchant' so that people and the outcomes of organizational processes can be made into strategic advantages.

These studies mainly offer a practical guideline of approaches on how HR can assume a strategic role. There are many more scholarly and commercial articles that provide useful advice for HR to become beyond their position. These implications do stimulate motivation for HR and perhaps the CEOs in allowing HR to transform into a value strategic business partner and player. But time and time again, not many of these HR practitioners will be able to rise like a Phoenix out of the ashes. Whether it's due to the political culture or the will of HR themselves this paper calls for an alternative approach to make HR become that desirable profession. Since HR is after all human the mind must be shaped to think differently in order to embrace these professional advices from some of the best HR gurus and mavens.

2. "What are the Obstacles that are Preventing HR from Becoming a Strategic Partner"?

To answer this research question, an open-end question form questions were asked to HR managers working at an industrial organization that are product-centered. The companies that these HR managers worked for were owned by the U.S., Japanese, British, German, and French based in the Lamphun province of Thailand. Twelve questions were sent out and nine responded back. The names of these companies that the HR managers represented were the SMV company, Keihin, Abbeycrest, Hana Microelectronics, Lanna Products, Thai-Sakae Lace, Bluechips Microhouse, Murata Electronics, and Label Bank Asia. These same questions were also asked to general individuals who were working as top managers and regular staff members at organizations that were non-product centered. The questions were structured as followed:

1. What is the role of Human Resources Management?
2. How does HRM add value (for an organization)?
3. Does HRM contribute in making the organization effective?
4. Where can HRM improve in developing an organization?
5. How important is HRM to an organization?

These questions asked to the participants were aimed to find out what the HR staff is currently doing to be viewed as a strategic partner and to gather the perception of non-HR staff in how they see this profession implementing the practice.

Analytical Insight to the Response of HR

1. HR defines their **role** by the function that they do on a weekly basis. The functional role of recruitment, compensation & benefit, training & development, employee relation, performance evaluation, and retaining employees is to make sure that they are all aimed (catering) towards meeting the organizational objectives. One of the main objectives is to ensure efficiency by directing the labour to be productive in meeting the demands of the organization's clients, reducing unnecessary expenses and

expenditure. HR enforces the rules and regulations to ensure that working operations are running on a smooth basis.

2. HR **adds value** by coordinating the working conditions and systems to direct the behavior and skills of the organizational staff to meet the objectives with efficiency. The focus is on safety and security of staff as this is believed to generate motivation on the part of the workers. HR has to focus on keeping the company at a subsistent level by making sure that they have competent people; in theory competency eliminates damage to the work operation.
3. HR **contributes in making their organization effective** by identifying and detecting any mistakes that might cause the work production to slow down. HR claims accomplishment to organizational effectiveness by measuring their company's profit sheet and the number of staff participating in activities. HR designs the policies and procedures for reducing wastage of resources, time, and energy as well as improving the work system that results in productivity.
4. HR can **improve** by getting their staff to see how their job is connected to the organization's mission and values; they will feel more motivated and get a clear picture of their role. HR has to find a better way of making the financial statement to be a lot more positive than negative; the bottom line (finished product up-to-standard) must be maintained.
5. HR shows its **importance** by re-shaping policies, process, and procedure to meet the objectives. HR upholds their organization competitiveness by targeting skilled people for recruitment. Gaps in skills are quickly identified and training is arranged for the purpose of keeping the work performance on track to maintain the organization to stay competitive in the long run. HR devises the working system to obtain results.

Analytical Insight to the Response of non-HR personnel

1. They administer work policies and procedures. HR recruits new staff, evaluate work performance, providing training, deal with working relations, handling compensation & benefits of the staff.
2. There wasn't much elaboration for HR adding value to the organization. HR perceives to add value when they select the right person for the job and provide residency assistance for newcomers.
3. In terms of contributing to organizational effectiveness, there was not much to say. As long as HR is able to retain qualified staff then they've done their job.
4. In their opinion, HR needs to improve in helping to make the financial sheet look good. Better training programs and learning opportunities should be designed to meet the needs of staff and to make them effective in their job role.
5. ** HR is important in a sense of providing information and support of the work system. However the organization can survive temporarily without them.*

Criteria	Human Resources	Regular Staff
Role	• General/administrative function (recruiting, training, compensation + benefits, performance evaluation) • Ensure efficiency by directing the labour to be productive in meeting the demands of the organization's clients, reducing unnecessary expenses and expenditure • Enforces the rules and regulations to ensure that working operations are running on a smooth basis	• administrate work policies and procedures. • HR recruits new staff, evaluate work performance, providing training, deal with working relations, handling compensation & benefits of the staff.
Adding-Value	• Coordinating working conditions and systems to direct behavior and skills of staff to meet the objectives with efficiency. • Focus on safety and security of staff to generate motivation and morale of the workers. • Concentrate on keeping the company at a subsistent level by making sure that they have competent people; in theory competency eliminates damage to the work operation.	• Not much elaboration. • When they select the right person for the job, support learning opportunities and build a positive working environment.
Contribution to Organizational Effectiveness	• Identifying and detecting any mistakes that might cause the work production to slow down. • Accomplishment by measuring their company's profit sheet and the number of staff participating in activities. • Policies and procedures for reducing wastage of resources, time, and energy as well as improving the work system that results in productivity. Only workers who perform efficiently will be retained.	• Not so much information. • As long as HR is able to retain qualified staff then they've done their job.
Area for Improvement	• Getting staff to see how their job is connected to the organization's mission and values; they will feel more motivated and get a clear picture of their role. • HR has to find a better way of making the financial statement to be a lot more positive than negative; the bottom line (finished product up-to-standard) must be maintained. • HR needs to develop a career path for their staff, identify the skills and abilities required for the job, and build up the competencies of line management; need to create a learning environment.	• Helping to make the financial sheet look good. • Better training programs and learning opportunities to meet the needs of staff and to make them effective in their job role.
Importance	• Re-shaping policies, process, and procedure to meet the objectives. • Gaps in skills are quickly identified and training is arranged for the purpose of keeping the work performance on track to maintain the organization to stay competitive in the long run. • Planning the work system to obtain results. All functional tasks and practice of retaining workers, creating positive work conditions, and good relations are driven towards the company's existence and goals.	• ** Important in a sense of just providing information and support for the work system. However the organization can survive without HR for a temporary period of time.*

This chart depicts how HR see themselves and how regular working staff view HR from five different principles.

Findings from the data

We see that HR has not really transformed its role to be what Ulrich has recommended. The general function and administrative tasks of HR has labeled the profession to be viewed by themselves and others of what they do rather than what they could really do – it's the term "what you see is what you get".

The practice of HR, in an industry where it is product-centered, demands that the role provides a strong support in making their organization highly competitive and has a prolonging existence in the market. The attitude and opportunity to be a strategic business partner, change agent, employee champion, and administrative expert have been diminished due to the pressures of meeting the financial objectives and needs of the corporation.

Rather than seeing HR practice its profession to be more innovative and lenient towards the human side it is clearly seen that HR has converted itself into being a police officer within their organization. HR has to make sure that the systems and policies are complied to. Any signs of defect or deceleration of productivity must be immediately addressed in order to ensure that the financial and profit statement shows a high positive rate of return. Any staff being seen as unproductive is subjected to immediate training or reprimanding. HR must perform in a clockwork fashion because efficiency rules over effectiveness. They carry out their roles as the proctor of an exam; detecting and monitoring any signs of errors or resistance towards the operational system. The numbers are more important than what people feel or think.

Even if HR tries to demonstrate the human side of their function (retaining, motivating, and creating a positive working environment) it would be considered as a desperate attempt to feed the objectives of being more efficient in the workplace. HR works on a practical theory approach where the system is fine. The procedure is considered correct overall and should not be changed. The system needs to run its course even if it means running over others who do not agree. According to HR it is the people who need to be changed in order to fit into the modus operandi like a box.

Therefore, it's no wonder that HR is looked upon more as a traffic officer by non-HR staff. From the views of other, HR is seen as a mere profession that can be done by anyone. Thus it answers the question on *"the obstacles preventing HR from becoming a strategic partner"*.

The call is for HR to stop relying on the system and start to think more like entrepreneurs who see people as a customer and client to be served with dignity and respect. HR needs to go beyond its current functional task and become part of a leader where people truly matter.

3. An HR Framework for a New Outlook.

It was mentioned in the literature review that Aughton (2005) suggested that HR needs to frame a new mental model that will make others take notice and listen to the profound and sustainable benefits HR brings to organizations in the new economy. He advises HR to mind-frame their organization operating within its environment and to be a competent in using state-of-the-art systematic tools and concepts designed for adding value to stakeholders. He feels that this idea will enable HR to see their organization from a different

view. Leadership expert, John C. Maxwell (2003), tells us that "we are either the masters or the victims of our attitudes". At times, the mind perceives thing to be as is and hardly view how things could be. This research proposed that HR develops the mindset before moving on to the mental model. Edward De Bono has introduced an innovative way for the mind to make sense of things. Coined as the phrase "parallel thinking" De Bono mentioned this idea as a way for both individuals thinking in congruence. In theory, these individuals will think co-operatively and in a coordinated fashion while going in the same direction. The direction itself can be changed in order to give a full scan of the situation. But at every moment each thinker is thinking in parallel with all the other thinkers. There does not have to be an agreement. Statements or thoughts which are indeed contradictory are not argued out but laid down in parallel. In the final stage, the way forward is 'designed' from the parallel thought that have been laid out. In general parallel thinking is a further development of the well known lateral thinking processes, focusing even more on explorations — looking for what can be rather than for what is. (De Bono, 1999) In his work for helping to develop a learning organization, Peter Senge offers another way that can shape HR's attitude. This would not only overcome doubt and impossibilities but also see how things are interconnected and where they can truly make a contribution towards organizational values. In its most eloquent meaning, Senge describes systems thinking as a discipline for seeing the whole…."seeing the structures that underlie complex situations, and for discerning high from low leverage change…All are concerned with a shift of mind from seeing parts to seeing wholes, from seeing people as helpless reactors to seeing them as active participants in shaping their reality, from reacting to the present to creating the future." (Senge, pg. 69, 1990) With this information HR can see that they are not really a lone unit that monitors the working procedure free from lawsuits, conflict of interests, and other political deceptions. Instead, HR should see itself as a business partner that is aimed towards enhancing the performance of others so that they can create prosperity within their organization. Senge (pg.73, 1990) also states that the essence of the discipline of systems thinking lies in a shift of mind:

- Seeing interrelationships rather than linear cause-effect chains, and
- Seeing processes of change rather than snapshots

By means of De Bono's parallel thinking concept and Senge's systems thinking, when we compare the general functions between HR and Marketing we find that they are very much similar in content. What HR and Marketing do have in common is that they deal with people. Their craft of dealing with people are the means for developing an interpersonal relationship. Cobb, Samuels, and Weston (1998) believe that HR can reap additional benefits by learning more about the marketing of services including the marketing of their own services to their internal customers. They feel that the skills and knowledge of HR should also flow to marketing. To support this study, they cite the work from Berry on the importance of treating employees as customers. The suggestion is for companies approaching their employees with the same empathy and concern for satisfying their needs as the employees themselves are expected to display when dealing with external customers. It is the belief that employees respond to company policies and practices in ways similar to customers; customer retention and employee retention should be examined together. The next part of this research shows the similarities between the tasks and functions of HR and marketing.

Recruitment & Selection/Segmentation, Targeting, & Positioning

When HR has to recruit a person for a certain job position they look for individuals who have good qualifications or high potentials otherwise known as a candidate or prospect. Of course HR doesn't go all over the planet to find the prospect. They have to find out where that prospect is located so that they can implement the right method for persuading that person to join HR's organization. If we use the U.S. Army recruiting method as an example we see that they already have the right person or people in mind to join their organization. Gathering intelligence on the typical profile of their prospect the U.S. Army quickly mobilizes in carrying out a plan of convincing these individuals to enlist for the armed services. With a target number set, these recruiters have to decide very carefully on the best economic situation of getting the most with the least amount of resources. Communication is the best reliable tactic for getting into the minds and hoping to persuade these individuals to enlist. Despite the challenges and obstacles of recruiting to meet the target numbers the U.S. Army's no surrender attitude has spawn some innovative ways to get a handful of new recruits. Entertaining events such as sports and music concerts are the perfect ground to sign up young and energetic people. However, it's even more effective to get closer to the prospects if the event was sponsored; and this is what the U.S. Army did. To make it more effective the U.S. Army would bring in a sports celebrity into the event and provide the message about opportunities, a future, and personal development. The recipients of this message are the young men and women who are considered most likely to warm-up to the "sales pitch". The recruiting strategy on the part of the U.S. Army is to target mostly the younger generation. These are the selected groups that fit with the Army's profile of: the physically fit, the inexperienced but hopeful minded, the promising example that would remain with the service, and most importantly the ones that would exemplify leadership for the armed service organization. It's important that the U.S. Army recruits these people so that they sustain the organization's ideas and accomplish the stated mission as well as objectives.

No matter if the product or service is considered to be new or old, marketers still have to look for people who are interested in being engaged (purchasing, subscribing, or supporting) with what is being offered. According to marketers the people that they look for are known as customers. If the market is highly competitive marketers know they have to go beyond then just making the sales. However, not every product or service created is made for the market demand nor is it created for everybody. Therefore, marketers have to find a way to ensure that the strategy to be deployed will be economically favorable. The approach here is to segment, target, and position to gain a competitive advantage in the market. The idea is to differentiate the product or service offered from the competitors. Market segmentation is the process of dividing the market into similar groups according to the characteristics intended for the product at hand. Targeting is the process of selecting the most lucrative market segments for marketing the product. Positioning involves the formulation of a definitive marketing strategy around which the product at hand would be finally marketed amongst the target audience. Like the U.S. Army recruiting campaign, marketers have to come up with an innovative way to convert people into customers; it's either buy or die.

Employee/Customer Retention and Loyalty

The function of retention and loyalty managed in the hands of HR or Marketing is very similar.

Bob Thompson (2005), the CEO of CRMGuru.com, presented his work at a business seminar on how to retain customers by developing loyalty. Thompson used the findings of the Walker Information, as an example, on how the loyal customers of the IT industry were primarily driven by:

• *Attitudes*—about brand, quality and customer focus

• *Brand Images*—as an industry leader, trustworthy company and innovative supplier

• *Customer Experiences*—with product quality, purchase process, technical support and consulting

According to Thompson, "the Walker study also found that "price contributes to how customers view the value of what they buy". However, "price by itself doesn't contribute a great deal to customer loyalty." No matter if it's an employee or customer the idea from Thompson should be in the viewpoint from an ordinary person. A person will most likely develop positive relationship with an organization as long as important business values, such as Thompson mentioned (attitude, brand images, and customer experiences), are constantly reciprocating.

An article from Workforce.com (2001) demonstrates how a company incorporates the value of loyalty and retention that produces a simultaneous feeling of satisfaction among their staff and customers.

In The Loyalty Effect and Loyalty Rules, Frederick F. Reichheld highlights several companies that have built value by building loyalty among customers and employees. One of them, Chick-fil-A, an Atlanta-based fast-food chain, has exploded from one diner to more than 960 restaurants in 34 states and South Africa in the past half century.

In an industry where the average turnover rate among store operators is 35 percent, it's less than 5 percent a year at Chick-fil-A. Store-operator candidates are graduates of such places as West Point and Annapolis. They've had jobs in major management consulting firms. So why do they go to Chick-fil-A? Reichheld says, "Founder Truett Cathy has so effectively marshaled loyalty-effect economics that he can afford to let his operators earn double or triple industry average while still generating sufficient cash to grow the chain while remaining a private company."

Chick-fil-A "aligns the interests of outlet operators with those of the company, and gives the customer ultimate power over both," Reichheld says. The company offers operators the chance to earn $200,000 to $300,000 a year, with only a $5,000 up-front franchise fee. Every operator gets a $30,000 salary, and 50 percent of the store's net profits. If the store succeeds, they succeed. (And if the operator decides not to continue with the company, she gets her $5,000 back, as long as the restaurant's books are in order.) The operators "concentrate on building their store's profit pool by providing customers with the best possible value and service," Reichheld says. (Workforce, 2001)

Performance/Marketing Channels and Supply Chain Management

In Michael Basch's book "Customer Culture: How FedEx and other great companies put the customer first everyday", he describes how Federal Express' obsession with the conscious development of customer-focused system s and the use of technology has enabled it to maintain market share in the face of ruthless competition. (Basch, 2002) The founder of FedEx, Fred Smith, also knows very well that if the corporation doesn't stay focused then its partners (suppliers of necessary resources and equipments) will become nervous and start to do business with the competitors. Systems had to be developed in order to ensure the longevity of the corporation. Basch exert's Smith's quote by saying: "Maintaining the spirit of the entrepreneurial company while doubling every year and moving toward bigness is a formidable task and can only be accomplished by systematizing nearly every part of the operation, from how people get their jobs to how packages are sorted and tracked to what planes fly where and who flies them….By systems here, we don't mean just information systems, but rather cause-and-effect systems….People are driven primarily by systems as used in this context. Well-designed systems tie choice and actions to outcome. FedEx sees treats the supply chain as a supporting cast of its business. It shares with its partners on the aims that are targeted for achieving. For FedEx, the goal of any organization is to build a culture that continually evolves to deliver greater and greater value to its customers over time, which will lead to greater and greater sales and profits over time. FedEx builds this on a vision of ever-increasing value to customers. They do this by addressing the needs of their customers in the view as being human in the first perception. FedEx refers to the needs as followed:

Physical – Physical needs include making it easy and convenient to do business, getting a quality product, being comfortable in the buying or delivery process, and so forth.

Informational – The customers need to be informed about the progress or whereabouts of their item. Just knowing what makes the customer feel rest assured that the promise will be delivered. FedEx uses Internet Ship which e-mails the recipient that the package is on its way and includes a tracing number for the recipient, giving both shipper and receiver total control.

Emotional – Knowing that the package that is going to be delivered on time generates a piece of mind and confidence that ownership will soon arrive into the recipient's hand.

Spiritual – This signifies a greater purpose where people (customers and employees) see that they are part of something greater than themselves. (Basch, 2002)

FedEx is in this competitive business to win. It's highly defined values places it as the market leader of logistics. FedEx wants the supply chain people to work as a partner to help FedEx accomplish their mission and reach their goals. If FedEx is able to do so then, this would maintain the market status of the supply chain players as well.

Southwest Airlines practice of providing the best value-service has changed the way customers relate towards acquiring the services from other companies. There is no longer a sense of feeling inferior or guilty for demanding better service. Customers are strongly value- oriented. They seek results and service process quality that far exceeds the price and acquisition costs they incur for a service. Customers who choose to do business with Southwest Airlines perceive high value even though the airline does not offer all of the

amenities provided by its competition. Management of Southwest knows that high levels of customer satisfaction result from the airline's frequent departures, on-time service, friendly employees, and very low fares because its major marketing research unit (the 24,000 employees) is in daily contact with customers and reports its findings back to management. At one point, the airline's value-service was seriously challenged when two major airline reservations systems ceased providing information regarding its flights to travel agents because Southwest did not utilize the systems for making reservations, thereby yielding no revenue to the systems' sponsoring airlines. This made it more difficult for passengers to obtain tickets. Southwest management lived and died by the sword of the value-service. They decided to introduce a ticketless service whereby passengers needed only to change their reservations to their credit cards, obtain ticket confirmation numbers from the Airline, present them along with some identification at the gate, and board their flights. What looked like a problem that was going to destroy the credibility of Southwest quickly converted to a 15% increase of ticket sales volume. Southwest was able to accomplish the increase of ticket sales due to keeping in close contact with a very special customer. This special customer, known as AmEx Travel Services, resembled the same character as Southwest in putting the customers' needs before the organization itself. AmEx provided value-service beyond the producing the results and processing quality. This company did a study on the psychological behavior side of the customer and discovered that "customer convenience" and "quick process" actually outranked "best airfare" as factors driving customer satisfaction and travel office profitability. (Heskett, Sasser, Schlesinger. 1997)

The characteristic traits of providing value-service to customers have bonded Southwest and AmEx to work as a team in making certain that their customers will always be fully satisfied. Here is a good example of reinforcing the supply chain with a similar view towards understanding your customers' needs.

Employee/Public Relations

HR does itself a favor when it collaborates with non-profit or government organization in helping society progress towards a future. When HR puts itself in this position they portray an image that reveals the profession of being capable to go beyond internal matters. Working with projects or ideas for the benefit of humanity gives an opportunity for HR to not only develop their career but also moving into the role of being seen clearly as a strategic player. Because the works of non-profit organization and the government are always under pressure to produce results HR should embrace this as a blessing for cultivating their profession. An article from "workforce.com" sheds a light on HR by describing a situation where a company decided to take matters in their own hand to ensure that people can gain access to making a living.

In the late 1990's, the United Parcel Service (UPS) was trying to staff its large package-sorting plant that was located outside of Chicago. At that time, new jobs were being created at a record pace - approximately 70 percent of them in the suburbs. Yet despite these opportunities, many residents of urban neighborhoods don't apply.

Why? The jobs are available. The people are qualified. Where's the disconnection?

The problem was - and is - transportation. Without their own transportation, job candidates living in urban locations simply don't have a way to get to work in the suburbs. They don't apply for these jobs because they just can't get there.

The solution to the problem is a bit more complex. It involves issues that employers sometimes like to avoid: grass-roots politics, deep community involvement, working with public agencies. But over the past two years, UPS, the nation's fourth-largest employer, faced the challenge head-on and created a transportation solution - and a blueprint for solving this growing dilemma.

The result? Through this unique public-private access-to-jobs transportation program, UPS now moves 3,300 part-time employees per day from the inner city to the company's sorting facility in the suburbs. Turnover rates are low. Employees are thriving. UPS has a motivated, dedicated labor pool.

For 93 years, UPS has been in the business of delivering packages to people. In Chicago, the company has found itself in the business of delivering people to jobs.

For UPS, the company was dedicated to finding a solution. They were trying to find a way of obtaining plenty of people to work for the company while these people living in the city needed jobs. The question was: How could we bring the two together?

The concept of creating a transportation solution had been tossed about early in the life of the facility. So the idea was there, but UPS wanted to take it to a whole new level.

In this article, UPS needed to have an established support from others in order for this program to work. An effective access-to-jobs program requires three key players: a company with jobs, a community with interest, and a transportation entity willing to work with both. Putting together - and nurturing - this triad is the most important and perhaps most difficult step. Equal commitment from all three "legs" is required for the program to stand. And it is the company's responsibility to maintain the relationship.

Upon evaluation, it was evident that a lack of personal transportation often isolated residents from good-paying, career-oriented jobs. The representative of Chicago, Danny K. Davis, stated that "Local employment opportunities have diminished dramatically and that in the past 30 years the congressional district has lost about 130,000 jobs. Many citizens were hard pressed to find employment because a significant number of available jobs are in places away from where the people live. Because you can't always bring the jobs to the people, there had to be a way figured for getting people to where the jobs are. People view a lack of reliable transportation to and from work as a recipe for failure. They don't apply if they're not sure they can get there regularly."

UPS took Davis's words to heart. The company set out a mission that reflected on a philosophy to develop an access-to-jobs plan that would remove the perception that a lack of transportation was a barrier to employment. The solution was to develop, implement, and communicate a reliable, affordable, and safe mode of transportation. These three criteria had to be met or it would fail.

The Seventh Congressional District would be the initial focus for the UPS effort. And Congressman Davis and his constituents would be the crucial community partners that UPS needed to begin designing a workable long-term transportation solution.

UPS then had to form a partnership with "Pace Suburban Bus System" which is the transportation agency. The agency was not interested in participating at first. The relationship started with a bad beginning. Despite the situation, UPS relentlessly worked to normalize and solidify the partnership. They were sensitive to Pace's overall mission and business needs and had to find a method that would be winning situation for all. The UPS program was put forward by developing the preliminary sketch of a proposed bus route.

The UPS team identified suggested stops and departure and arrival times, with no commute longer than one hour. They then presented the plan to Pace, which performed a feasibility study, emphasizing route compatibility, connecting service, and other factors. Pace then determined an operating cost for the implementation of the new service. UPS agreed to cover the cost of the dedicated routes.

In exchange, UPS received that same value in monthly transit passes, valid all over the city 24 hours a day. Employees do not have to buy the passes; they can continue to pay cash. But the UPS employee discount is compelling. The face value of the card is $75; UPS offers it to employees for $50. If the person rides only Pace to and from work, a monthly commuter pass is $49. UPS offered that to their employees at $25. Basically, it works out to a little over $1 per day that the riders pay to get to and from work.

This arrangement is a winner. The transit agency expenses are covered. UPS can recoup some of its seed money by selling the passes to employees. And riders have access to bus transportation citywide.

The cost to UPS? About 70 cents per rider per day.

Representative Davis was really pleased about the benefits for his constituents. He makes the following comment:

"The bus is a reliable, safe and affordable means of transportation, and effectively breaks down the barriers to employment for our community…..What really pleases me is the kind of work that our citizens are able to secure with UPS. They receive good pay and excellent insurance benefits. They are also able to receive tuition assistance for school or college. This provides workers with the opportunity to grow and move beyond where they are to get where they really want to be…….This has been a successful program because UPS has empowered people with the responsibility to coordinate, facilitate and take a hands-on approach to make this initiative happen. I feel that through this program, UPS has bettered the lives of people within my community and given them hope for a brighter future." *(Workforce, February 2001, Vol 80, No 2, pp. 106-111)*

Marketers not only have to devise a plan for making sure that they stay competitive in the market but also to be prepared when the worst things happen. A slump or lost in sales may not be so devastating when it is compared to a situation where the product or service that is being marketed is identified as doing severe harm to the public. Here is a situation dating

back in 1982 where a company took corporate responsibility in restoring faith and confidence. When it was discovered that numerous bottles of its Extra-Strength Tylenol capsules had been laced with cyanide and that seven people had died, Johnson and Johnson decided it was best for the company face the major crisis rather than stay silent or express words of extrication. How Johnson and Johnson dealt with this situation set a new precedent for crisis management. The company was lauded for its quick decisions and sincere concern for its consumers. Despite initial losses, Johnson and Johnson regained and exceeded its previous market share within months of the incident.

The Executives of Johnson and Johnson knew that in order for the future of the company to keep growing then tough decisions had to be made. Rather than think in financial terms, however, CEO James Burke immediately turned to the company's Credo. Written by Robert Johnson in 1943, the document defines the focus of the company as its customers. With this as its inspiration, Tylenol used the media to promptly begin alerting people of the potential dangers of the product. It dispatched scientists to determine the source of the tampering.

According to following article from the University of Florida, Johnson and Johnson then made a decision that would set a new standard for crises involving product tampering. The company ordered a massive recall of more than 31 million bottles at a cost of more than $100 million.6 It also temporarily ceased all production of capsules and replaced them with more tamper-resistant caplets. This type of drastic response had never been attempted, which prompted much criticism. However, Johnson and Johnson stood firm behind its decision - and for good reason. The company was able to "use the crisis to demonstrate to [its] customers [its] commitment to customer safety and to the quality of the Tylenol product."7 In addition, the company's willingness to be open with the public and communicate with the media helped the company maintain a high level of credibility and customer trust throughout the incident. Burke also maintained a high profile and repeatedly assured the public of the company's commitment to its customers' safety.
The incident caused the company's stock to fall seven points; it dropped from having 35 percent of the nonprescription pain-reliever market to having only eight percent of the market. The times were tough for Johnson and Johnson but the company itself knows that these tough times would not last. The company aired commercials within days to regain the public's trust, and a month after the recall, the company embarked on an aggressive campaign to rebuild the Tylenol brand. In November, it promised to have the product back on the shelves in a new triple-tamper-resistant package - the first of its kind - by the end of the year. It offered incentives, such as a free replacement of caplets for the capsules and special coupons, to try to maintain its customer base. The company's attempts were successful, and by the following spring, Johnson and Johnson had regained its previous market share. When another poisoning involving a New York woman occurred four years later, Johnson and Johnson once again had to take action. "Because the company had been through it before - the tampering, the tragedy, the scrutiny of news organizations - its executives knew how to handle it." Despite the fact this case was soon identified as an isolated incident, Johnson and Johnson decided to permanently discontinue capsule products - once again demonstrating its commitment to putting safety first.

The actions of demonstrating good relations with people on the part of UPS and Johnson & Johnson puts them in a highlight where the bottom line isn’t just about taking an efficient approach to making money. Organizations have to realize that they too have an impact with

their social and economical surroundings. Therefore it is important to do well (as in the case of UPS) as well as to restore goodness (as in the case of Johnson & Johnson). Addressing the issues of health, safety, and well-being on the part of the people rather than just the financial numbers will build a long and lasting relationship with the stakeholders.

Training & Development/Branding

Neither the size nor historical data, an organization's brand is the most important capital that allows for it to have longevity and prosperity. Without a brand the organization would be like a ship lost in the sea, just drifting along aimlessly without any sense of identity to itself or others. In their book called "The Power of Cult Branding: How 9 Magnetic Brands Turned Customers into Loyal Followers" Ragas and Bueno (2002) confers how brands are spheres of influence, and the most magnetic brands flat out win in the marketplace. They get repeatedly chosen over the competition. They bring higher prices than the competition. And if they're a strong enough brand, their customers not only use their products, but evangelize to the world about them….Magnetic brands sell more products and make more money than the competition….Most important though, magnetic brands exhibit a high degree of customer loyalty. Their customers not only choose their product or service over the competition once or twice, but do so week after week, month after month, and year after year. Customers are hooked and happy, and that's what really makes their loyalty such a beautiful thing for businesses.

However, in order for a brand to be that effective successful companies, such as the ones that have been previously mentioned above, need to have their own people build it from the inside out. It's not the tools, the machines, the papers, the tables, nor even the systems that will deliver value to the customers or clients. It's your staffs who are the most important part of the organization. If people are treated like human and not as objects then surely they will become the heart and soul of your organization. In "Customer Mania: It's Never Too Late to Build a Customer-Focused Company", Blanchard, Ballard, and Finch (2004) convey that people are the most important resources. Blanchard himself states that "leadership that emphasizes judgment, criticism, and evaluation is a relic of the past. Great leadership today is about treating people the right way by providing the support and encouragement they need to be their best. When you treat your people like winners, they treat your customers as if they're the most important people in the world. The authors of this study points out to training and development as one part of the four keys in human resources development functions that will lead to a customer-centric focused organization. Blanchard informs of providing the appropriate training and development program for the new employees. The study by Blanchard, Ballard, and Finch used a case example of the world's largest restaurant company, YUM!, to show how the company provides extensive formal training programs to spread the word on values and give restaurant operators around the world the know-how they need to run great restaurants. It was in studying and following the lead of best-practice organizations such as Wal-Mart, Home Depot, Southwest Airlines, and General Electric that David Novak and his cofounders laid the foundation for what was to become YUM! Brands. Benchmarking is how they got their systems, visiting the best and constructing an integrated set of systems. Many companies that are the largest in their industry are characterized by an attitude of, "You can learn from me." YUM! reverses this. It's ever on the hunt for how to make its operation better by learning from others.

The company doesn't try to reinvent the wheel. They simply try to find out what works and apply it to the business. The principle installed in the company's practice is not being too proud to learn and change. The notion is to learn from anyone for executive training. Bureaucracy is eliminated. The 33,000 restaurants generate huge opportunities for people to make things happen. The organization tries to learn from them and transfer knowledge, so everybody can learn and use the best practices. According to YUM!, when the behavior is modeled from the best practices from other places it encourages continuous learning. YUM! constantly cites who they learned from so that their staff understand what it takes to be the best.

An organization's brand is only strong as its people commitment and discipline to make certain that it reinforces to be what it is and could be. The people who are attracted to the organization's brand appreciate the end result of what that brand is presenting. Clearly HR and Marketing is in the profession of developing the standard of living for their people (employees/customers).

Function Similarities Between HR and Marketing

Human Resources	Marketing	Basis of Function
Recruitment & Selection - Finding the right candidate	Segmentation, Targeting, & Positioning - Finding the ideal customer	***Getting the right person to help your organization prosper.***
Employee Retention & Loyalty - Compensation, benefits, and rewards	Customer Retention & Loyalty - Benefits, rewards, premium awards for new/current customers	***Displaying a sense of appreciation to the person that is contributing to your organization's growth.***
Performance Management - Knowledge & learning - Teamwork - Leadership & motivation	Marketing Channels & Supply Chain Management - Information sharing - Collaboration - Strategic Partnership	***Developing a trusting relationship with your associates.***
Employee Relations - Health & safety - Welfare & Guidance	Public Relations - Promoting image - Addressing issues of concern	***Endorsing a message of awareness and confidence towards the stakeholders on the part of the organization***
Training & Development - Improving knowledge, skills, and abilities - Career growth and enrichment	Branding - Emotional satisfaction - Expressing quality	***Creating value and opportunity for the recipient to upgrade their status.***

CONCLUSION

This study was aimed at creating HR to assume the position of a strategic partner. The profession of HR defines its role by what it does. They believe that value is added by coordinating the working conditions and systems to direct the behavior and skills of the organizational staff to meet the objectives with efficiency. Identifying and detecting any mistakes that might cause the work production to slow down is considered a contribution towards organizational effectiveness on the part of HR. HR feels the need to improve by getting their staff to see how the workers' jobs are connected to the organization's mission and value. And finally, HR shows its importance by re-shaping policies, process, and procedure to meet the objectives of their organization. In order for HR to become that ideal partner, this paper proposed the idea of entering the mindset of HR and to alter the current practice and belief. By maneuvering the content in the task and functions of HR to be a mirror reflection of marketing, HR can see itself as a leader in working and motivating people to achieve the goals and objectives without having to rely on policies, rules, and regulations in order to carry out the mission. This work doesn't suggest for HR to change its title or professional identity. Rather, the new way of thinking (letting the right eye be from a marketing point of view) would allow HR to go beyond its administrative role and to take on the character as a true strategic business partner. In order to integrate human capital into an organization's strategic objective, the HRM specialist has to take the role of an organizational pathfinder. This role requires gathering intelligence to see how the external market (in the social, economic, political, and/or technological context) is developing while at the same time equipping the staff's competencies to absorb shocks and convert challenges into opportunities. For HRM to be considered as a strategic objective of an organization they must install a sense of trust within the working environment that reciprocates in a seasonal business cycle. When the infrastructures of trust are in place, empowerment can be utilized to make workers feel that their contribution and effort not only deserves to be rewarded but have resulted in changing the positive lives of others around them.

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Evaluation of entrepreneurship policy for fostering SMEs Using a hybrid MCDM model

Wen-Hsien Tsai *, Department of Business Administration, National Central University, Jhongli, Taoyuan 320, Taiwan
whtsai@mgt.ncu.edu.tw

Hsiao-Chiao Kuo, Department of Business Administration, National Central University, Jhongli, Taoyuan 320, Taiwan & Department of Industrial Management, China University of Technology, Hu-Kou, HsinChu 303, Taiwan

Yu-Wei Chou, Department of Business Administration, National Central University, Jhongli, Taoyuan 320, Taiwan
***Corresponding author**

ABSTRACT

Entrepreneurship policy is a developing area of economic policies worldwide. According to green paper on entrepreneurship in Europe, Europe needs to foster entrepreneurial drive effectively and to enhance entrepreneurial vitality through entrepreneurship policy. Hence, how to evaluate entrepreneurship policy appropriately is becoming an important issue. This paper proposes a hybrid MCDM model combing with Decision Making Trial and Evaluation Laboratory (DEMATEL) method, analytic network process (ANP) method and zero-one goal programming (ZOGP). The purpose of the paper is to present an integrated model that could consider the interdependent relationship among criteria and alternatives and deal with the constraints on resources. As an illustration, the hybrid model has been applied to an empirical study of entrepreneurship policy in Taiwan. The result shows the model provides an effective problem solution to help policy makers to evaluate and select feasible entrepreneurship policy.

Keywords: Entrepreneurship policy, Decision Making Trial and Evaluation Laboratory (DEMATEL), Analytic network process (ANP), Zero-one goal programming (ZOGP)

INTRODUCTION

In the mid 1990's, world organizations such as the OECD, the European Commission and APEC put into efforts to investigate economy approaches to develop entrepreneurship (Lundstrom and Stevenson, 2001). Entrepreneurship has been viewed as an engine of economic growth and social development. It is not only a driver for company's

competitiveness and employment creation, but also is a vehicle for personal development and social problem solving (European Commission, 2003). Entrepreneurs are important to the innovation through the product, process, technology and organizational development. Moreover, they can transform their personal characteristics and ambitions into action. The purpose of the entrepreneurship policy encourages individuals to become an entrepreneur and provides service supports and necessary skills to foster Small and Medium Enterprises (SMEs) successful. Consequently, the need towards removing barriers to the business entry and exit, providing opportunities to start a business and stimulating entrepreneurial capacities and preferences will be an important task for the governments.

Although entrepreneurship policy has been developed by the countries, the evaluation models of the policy are deficient and it lacks an evaluation guideline. Since different perspectives and the allocation of the limited resources should be included in the evaluation models, the multi-criteria decision making (MCDM) approach is suitable for the evaluation of entrepreneurship policies. The paper proposes a hybrid MCDM model to solve this problem. First, DEMATEL (Decision Making Trial and Evaluation Laboratory) method is used to detect complex relationship and build a network structure among the criteria for the policies. We also extract the mutual relationships of interdependencies and the strength of interdependence among various criteria by using DEMATEL. Second, Analytic Network Process (ANP) method is used to decide the relative weights of the criteria. The Analytic Hierarchy Process (AHP) and the ANP are multi-criteria decision support methodologies proposed by Satty. The limitation of AHP is the assumption of independency among various elements of decision-making. However, ANP includes all the relevant criteria and alternatives of decision making problem to form a network and incorporate feedback and interdependence relationships. Therefore, we recommend the ANP method for the evaluation of entrepreneurship policy. Finally, we consider the priorities among multi-criteria and trade-off among the policy, ANP is applied to zero-one goal programming (ZOGP) formulation. The formulation use binary decision variable for each alternative and these take on values of 0 (the alternative is not chosen) or 1 (the alternative is chosen). The model combined with the priorities obtained from ANP and ZOGP could handle the interactions between the entrepreneurship policy and the constraints of resources.

The purpose of this paper is to develop an integrated evaluation model for entrepreneurship policy with regard to intertwined relations between criteria, alternatives and the constraints on resources. The reminder of the paper is organized as follows. Firstly, section 2 introduces evaluation framework of entrepreneurship policy. Section 3 proposes a hybrid model for attain the feasible entrepreneurship policy under resource constraints. We illustrate the methods of the Decision Making Trial and Evaluation Laboratory (DEMATEL) and analytic

network process (ANP) and zero-one goal programming (ZOGP). Section 4 presents an empirical case for entrepreneurship policy in Taiwan. Finally, the main conclusions from this research are proposed.

EVALUATION FRAMEWORK

The evaluation of entrepreneurship policy is concerned with the goal of the public policies, evaluating criteria and alternatives. At the same time, the allocation of restricted resource is considered. The evaluation is multi-criteria decision-making problem which consider complex factors as multiple evaluation criteria. We should apply MCDM methods to conduct it appropriately. Opricovic and Tzeng (2004) proposed that the main steps of MCDM are required to establish evaluation criteria related to the goal, develop alternatives for attaining the goal, evaluate alternatives in term of criteria, employ the normative multi-criteria analysis method, and accept one alternative as optimal. The evaluation framework in this paper consists of these steps as shown in Fig. 1. The detailed steps are described as follows.

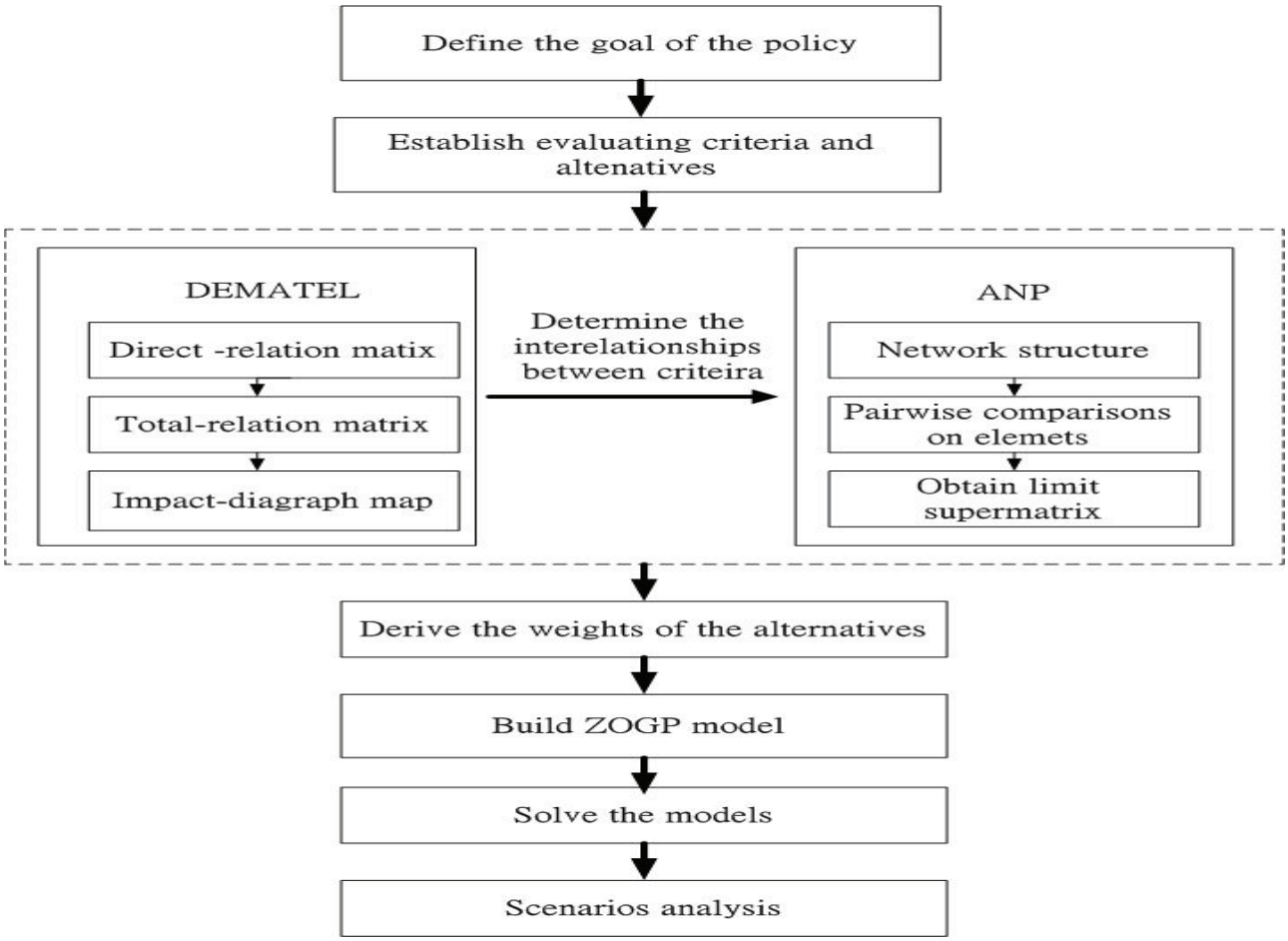

Fig. 1. Evaluation framework of entrepreneurship policy

In the section, the evaluation model is established. In order to evaluate and select the optimal entrepreneurship policy, three kinds of evaluation clusters consist of the goal of the policy,

evaluation criteria and alternatives. In step1, we define the goal of the policy according to the vision and strategies of economic policies for fostering SMEs. According to the Green Paper in Europe, entrepreneurship policy options related to two issues: how to have more entrepreneurs and how to get more firms to grow. The goal of the policy is to enhance entrepreneurial vitality by motivating and equipping entrepreneurs with the necessary skills. In additions, the governments should provide the supportive environment for business to start, stop, take over, thrive and survive (European Commission, 2003). Lundstrom and Stevenson (2001) define that entrepreneurship policy could encourages more people to consider entrepreneurship as an option, move into the nascent stages to get started early stages and proceed into the infancy and early stages of a business. Referring to Lundstrom and Stenenson (2001), the goal of entrepreneurship policy is to create an environment and support system to foster the emergence of new entrepreneurs and the start-up and early stage growth of new firm.

In step 2 the criteria should be determined which can achieve the goal and objectives of the entrepreneurship policy. Because entrepreneurship policy is an emerging area of economic policy development and relatively new phenomenon, Lundsrom and Stevenson (2001) introduced the preliminary framework of entrepreneurship policy measures. The framework integrated three main areas of motivation aspects, skills aspects and opportunity aspects and six measures which consist of loan for new business and start-up financing, business start-up support, reduction of entry barriers and elimination of obstacles, promotion, entrepreneurship education and Target underrepresented groups (Fig. 2.). In this paper, we use the concepts of entrepreneurship policy measures proposed by Lundsrom and Stevenson (2001) to be the evaluation criteria of the policy.

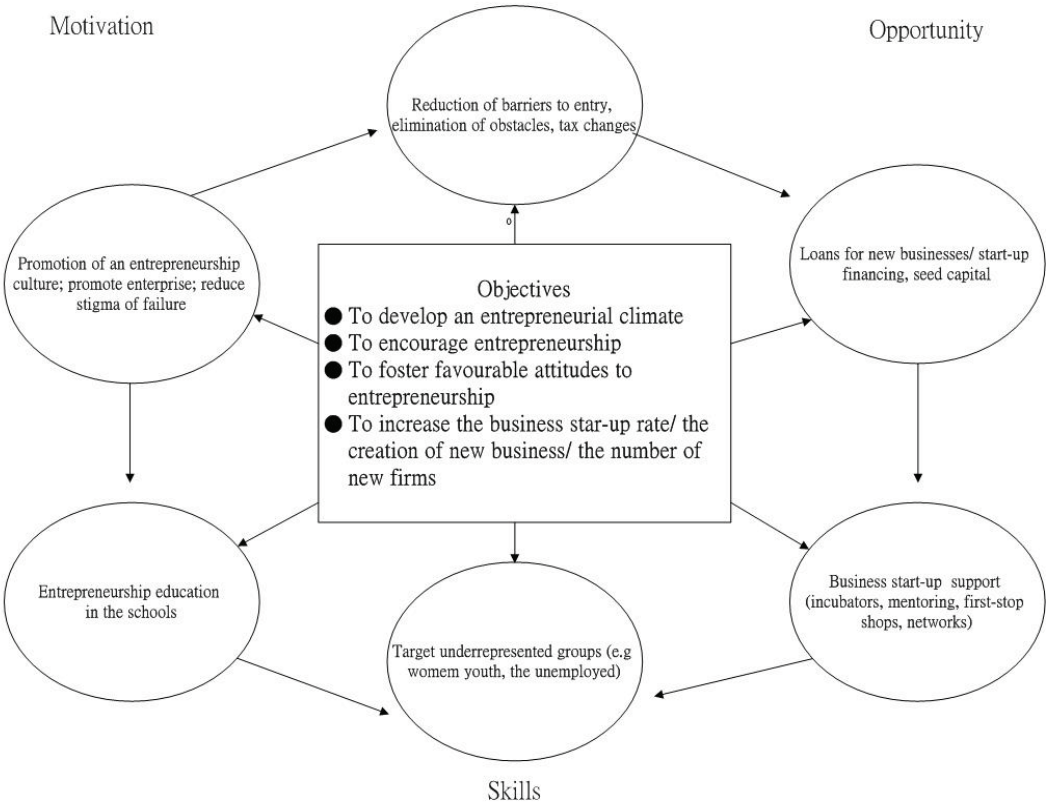

Fig. 2. Framework of Entrepreneurship policy measures
Source: Lundsrom and Stevenson (2001)

In order to construct the interrelationships between criteria and determine the weights of criteria and alternatives, in step 3 the model combines with Decision Making Trial and Evaluation Laboratory (DEMATEL) method and Analytic Network Process (ANP) method. Finally, in step 4 we applies zero-one goal programming (ZOGP) which is combined with the overall priorities of the alternatives to obtain the optimal policies with regard to the restricted resources. Scenario analysis is performed in various conditions to improve the model applicability.

EVALUATION METHODS

The DEMATEL Method

The DEMATEL method was developed by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva between 1972 and 1973. (Gabus and Fontela, 1972, 1973). The method was used for building a structural model involving causal relationships between variables/criteria and applied in many situations such as control systems, marketing, e-learning programs evaluation, airline safety measurement, and innovation policy portfolios and knowledge management strategies （Hori and Shimizu, 1999; Chiu et al., 2006; Tzeng et

al., 2007; Liou et al., 2007; Huang et al., 2007; Wu, 2007）. This method is summarized as below.

1. Calculate the initial direct relation/influence matrix: First, the comparison scale measuring the relationship between elements should be designated as 5 levels, where the score ranging from 0, 1, 2, 3 and 4 represent 'No influence', 'Low influence', 'Medium influence', 'High influence' and 'very high influence'. Next, Respondents are asked to make sets of the comparisons in term of influence and direction between elements. The initial direct relation/influence matrix A will be derived that is n × n matrix in which aij is denoted as the degree to which the element i affects the element j.

2. Calculate the normalized direct-relation matrix: The normalized direct-relation matrix N can be obtained through formula. (1) to (2).

$$X=K \bullet A, \quad S > 0 \tag{1}$$

$$K = \mathrm{Min}\left(\frac{1}{\max\limits_{1\le i\le n}\sum\limits_{j=1}^{n}\left|a_{ij}\right|}, \frac{1}{\max\limits_{1\le j\le n}\sum\limits_{i=1}^{n}\left|a_{ij}\right|}\right) \qquad i, j \in \{1,2,3,\ldots,n\} \tag{2}$$

3. Obtain the full direct/indirect relation matrix: The full direct/indirect influence matrix T can be obtained by using formulation (3), in which the I is denoted as the identity matrix.

$$T = X + X^2 + X^3 + \ldots = \sum_{i=1}^{\infty} X^i = X(I - X)^{-1} \tag{3}$$

4. Compute dispatcher group and receiver group: The D vector presents the sum of rows of matrix T and is the sum of the influences dispatching form element i to the other element. The R vector presents the sum of the columns of matrix T and is the sum of the influences that element i is receiving from the other element through formula (4)-(6). When i=j , ***D+R*** provides an index of the strength of influences given and received and show the degree that the element i plays in the problem. If ***D-R*** is positive, the element i is affecting other element and belongs to the dispatcher group, and if ***D-R*** is negative, the element i is being influenced by other elements and belongs to the receiver group. (Wu and Lee, 2007; Liou et al., 2007).

$$T = [t_{i,j}]_{n\times n} \qquad i, j \in \{1,2,3,\ldots, n\} \tag{4}$$

$$D = \sum_{j=1}^{n} t_{i,j} \tag{5}$$

$$R = \sum_{i=1}^{n} t_{i,j} \tag{6}$$

5. Set the threshold value and obtain impact-diagraph-map: To obtain an appropriate causal map, decision-makers set a threshold value for the influence level. The threshold value can be decided by the decision-maker or the brainstorming of experts. The elements whose influence level in matrix ***S*** are higher than the threshold value can be chosen and converted into the casual map. (Tzeng et al., 2007). The map will be obtained by mapping the dataset of (***D*** + ***R***, ***D*** – ***R***), where the horizontal axis ***D*** + ***R***, and the vertical axis ***D*** – ***R*** (Wu and Lee, 2007).

The Analytic Network Process (ANP) Method

We integrate DEMATEL result into ANP method to obtain the weight of each element. The Analytic Network Process (ANP) method and the Analytic Hierarchy Process (AHP) are well-known methods for solving multi-criteria decision making problems. The basic assumptions of AHP are that is can be used independency of the higher-level elements from lower-level elements. However, many decision problems involve the interaction and dependence of the elements. The Analytic Network Process (ANP) was proposed by Saaty in 1996 to release the restriction of hierarchical structure and dependence among the elements (Saaty, 1996). ANP enables interrelationships among the decision levels and attributes to be taken into consideration in a more general form. The network can include all related elements in any possible way and incorporate feedback and interdependence relationship within and between clusters. The applications of the ANP to MCDM problems have been: prioritising and designing rule changes for the game of soccer (Partovi and Corredoria, 2002); warehouse location for Digital Equipment Corporation (Sarkis and Sundarraj, 2002), financial crisis forecasting (Niemira and Satty, 2004), choice of best management alternatives of the supply chain in a company (Agarwal et al. 2006), resource allocation in transportation (Wey and Wu, 2007);valuation of urban industrial land (Beltran et al. 2008) and so on.

According to Saaty (2001), The ANP comprises these steps: (Berltran et at., 2008)
1.Construct the network and conduct pairwise comparisons on the elements. The relative importance value can be determined using a scale of 1 to 9 represent equal importance to extreme important.
2. Place the relative importance weights through pairwise comparison matrics within the supermatrix (unweighted supermatrix).
3. Conduct pairwise comparisons on the clusters.
4. Weight the blocks of the unweighted supermatix by the corresponding priorities of the cluster, so that is can be column stochastic (weighted supermatrix).

5. Raise the weighted supermatrix to limiting powers until the weight converge and remain stable (limit supermatrix).

$$\lim_{k\to\infty} W^k$$

Zero-One Goal Programming

The Zero-one goal programming (ZOGP) model has been applied in Multi-Criteria Decision Making (MCDM) problems and attains the objectives of an organization while considering restricted resources. (Chen and Shyu, 2006 and Liu and Hsiao, 2006). The GP model does not optimize the objectives directly. But it attempts to minimize the deviations between the desired goals and the realized results. In addition, these goals should be prioritized in a hierarchy of importance. The over and under achievements of goals is measured in GP using the so called deviation variables (Mathirajan and Ramanathan, 2007; Tsai and Chou, 2008). The ZOGP model used to set priorities by ANP. The solution to ZOGP will provide a pattern by which resources will be allocated among different policies. The ZOGP model is described as follows. (Lee and Kim, 2000; Wey and Wu, 2007)

$$\textit{Minimize} \quad Z = P_k(w_j d_i^+, w_j d_i^-)$$

Subject to: $a_{ij}X_j + d_i^- - d_+^- = b_i$ for $i = 1, 2, \ldots, m,\ \ j = 1, 2, \ldots, n$

$x_j + d_r^- = 1$ for $r = m{+}1, m{+}2, \ldots, m{+}n,\ \ j = 1, 2, \ldots, n$

$d_i^+ \geq 0,\ \ d_i^- \geq 0$ for $\forall_i$

$x_j = 0$ or 1 for $\forall_j$

Where Z is the sum of the deviation from *m* goals; *n* is the pool of the policies from which the optimal set are selected; P_k represents a preemptive priority ($P_1 > P_2 > P_3 >>> P_k$) for goal *l*; d_i^+ and d_i^- are the positive or negative deviation variables for the selection criterion (resource) *i*; w_j is the ANP weight on the jth policies; a_{ij} is policies parameter *j* of selection resource *i*; b_i denotes the available resource considered in the selection decision, and x_j represents the binary variable. The applications of the ZOGP to MCDM problems have been: Designing a quality control system in a service organization (Schniedejans and

Karuppan, 1995), university resource allocations and information infrastructure planning (Kwak and Lee, 1998), faculty course assignment (Ozdemir and Gasimov, 2004), a tour of a marketing executive (Mathirajan and Ramanathan, 2007) and so on.

EMPIRICAL CASE AND DISCUSSION: ENTREPRENEURSHIP POLICY IN TAIWAN

Problem Description

According to 2007 White paper on Small and Medium Enterprises in Taiwan, there are just 1.24 million SMEs in Taiwan in 2006, accounting for 97.71 of the all enterprises in Taiwan and over 108,000 new SMEs were established in 2006, accounting for 99.86% of all newly-established enterprises (SMEA, 2007). Undoubtedly, SMEs have been the foundation for Taiwan's economic development and provided the important contributions on society. In 2002, the Small and Medium Enterprise Administration (SMEA) of the Ministry of Economic Affairs has implemented the Challenge 2008 : National Development Plan including developing an international base for research development and innovation, establishing various types of innovation and R&D centers and developing Taiwan as an Asia Entrepreneurial center. In addition, SMEA established the mechanisms of SME entrepreneurship and innovation and built up learning system to create a knowledge-based entrepreneurial society. To build Taiwan into an entrepreneurial environment, the SMEA has been focusing on the measures of the entrepreneurship policy for fostering SMEs. The policy enhances function of incubation service, builds up an entrepreneurial knowledge and information platform, and provides financing support for Start-ups (SMEA, 2007). With regard to the condition of resources, capacities and preferences of the public policy, the paper sets Taiwan's entrepreneurship policy to be an empirical example and adopts our proposed method and set up a expert group. The following presents how the methods evaluate and select the optimal policies.

Applications of the Proposed Model

The work includes the expert group of five consultants in Taiwan's SMEA involved in evaluating entrepreneurship policies. First, the decision goal of the entrepreneurship policies is defined according to the vision and strategies of the SME policies formulation in Taiwan. In step 2, after conducting the entrepreneurship policy review and discussion, four evaluation criteria are defined. The four criteria include reducing barriers to entry and exit (RB), promotion (PR), entrepreneurship knowledge (EK), and financing and business support (FS). The four alternatives consist of dream actualizing project (E1), incubator center (E2), funding assistance (E3), and knowledge-sharing platform (E4). The decision structure for evaluating

the policies is formed in Fig. 3, in which looped arcs indicate that inner dependences are to be handled by the DEMATEL.

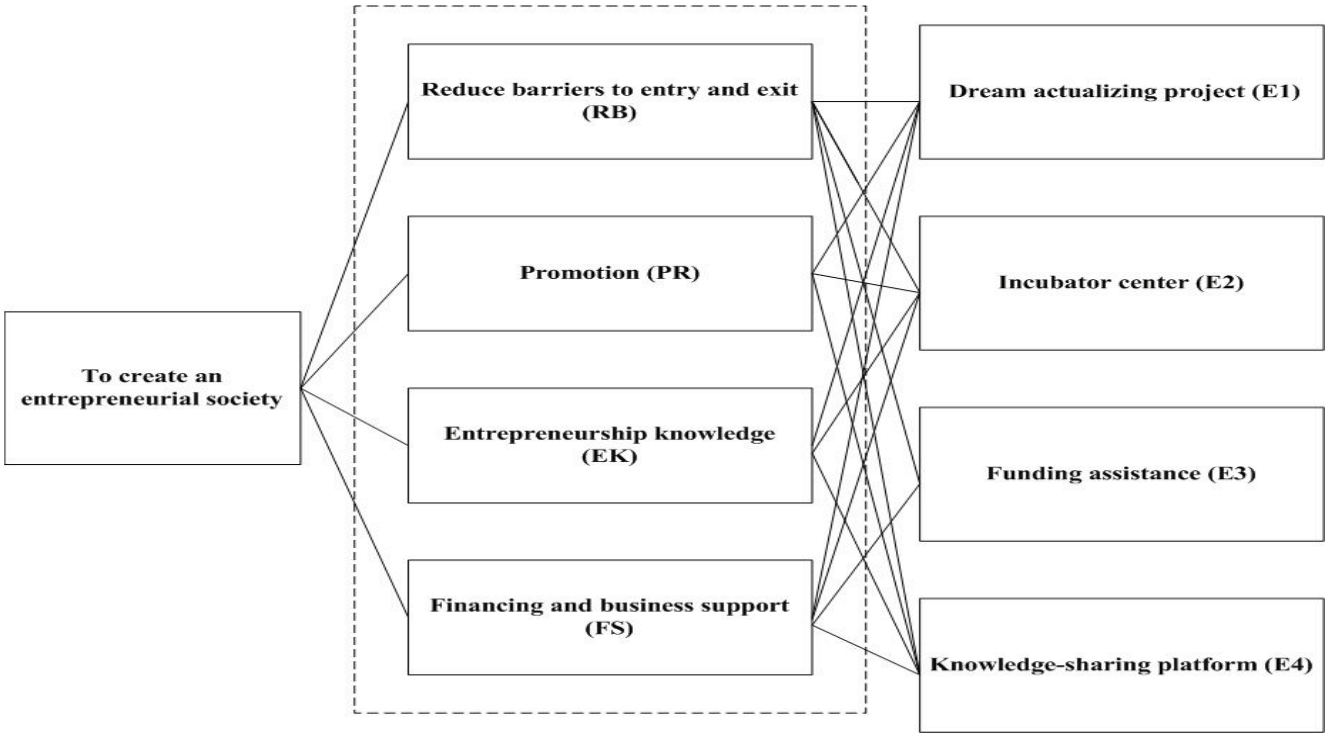

Fig. 3. The decision structure for evaluating entrepreneurship policy in Taiwan

In step 3, after using the 0-4 scale for making assessments, the relationships between the criteria are measured by the experts group and the initial direct-relation matrix is obtained (Table 1). Based on the initial direct-matrix, the normalized direct-relation matrix (Table 2) and total-relation matrix (Table 3) are obtained using the DEMATEL formula. Next, decide the threshold value 2.16 through the expert discussion. Based on the threshold value, the impact-digraph-map is obtained through the $D+R$ and $D-R$ value in Fig. 4. From the map, we know the criteria of RB and FS with higher D-R value are called master dispatchers while the master receivers are the criteria of PR and EK.

Table 1 The initial direct-relation matrix of four criteria

	Reduce barriers to entry and exit (RB)	Promotion (PR)	Entrepreneurship Knowledge (EK)	Financing and business support.(FS)
RB	0	2.2	2.8	3.6
PR	2.2	0	2.8	2.4
EK	3	2	0	2.2
FS	3.4	3.2	2.4	0

Table 2 The normalized direct-relation matrix of four criteria

	Reduce barriers to entry and exit (RB)	Promotion (PR)	Entrepreneurship Knowledge (EK)	Financing and business support.(FS)
RB	0.000	0.244	0.311	0.400
PR	0.244	0.000	0.311	0.267
EK	0.333	0.222	0.000	0.244
FS	0.378	0.356	0.267	0.000

Table 3 The total-relation matrix of four criteria

	RB	PR	EK	FS	D	D+R	D-R
RB	2.239	2.183	2.340	2.450	9.211	18.374	0.049
PR	2.160	1.739	2.085	2.104	8.088	16.215	-0.039
EK	2.189	1.900	1.825	2.073	7.986	16.615	-0.642
FS	2.575	2.305	2.379	2.226	9.485	18.338	0.633
R	9.163	8.127	8.629	8.853			

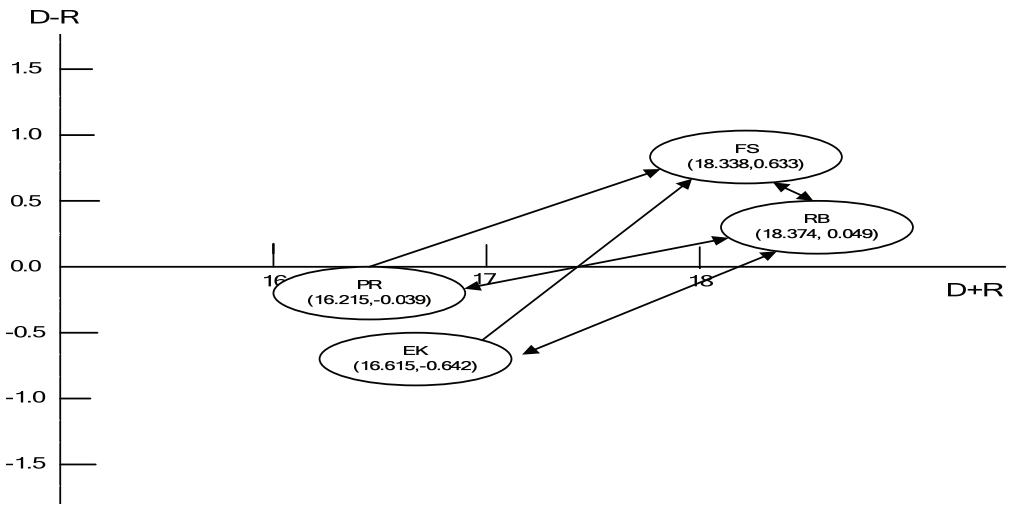

Fig.4 The impact-diagraph-map between four criteria

Under the determining the relative importance among criteria, we employ the ANP method to calculate the weight of each criteria and alternatives. First, the expert group responses to

questions for pair-wise comparisons with Saaty's nine scales. In order to aggregate the data, the geometric mean method was used for ANP. The ANP model is solved using the professional software named "SuperDecisions software". The unweighted supermatrix and the limit supermatrix are shown in Table 4 and Table 5. The result of the ANP phase are the priority weights for each evaluating criteria and alternative, namely W^{ANP}(E1, E2, E3, E4)= (0.351, 0.221, 0.280, 0.148). The highest weight of the alternatives is dream actualizing project (E1). The lowest weight of the alternatives is knowledge-sharing platform (E4). These weights are used as priorities in goal programming formulation.

Table 4 The unweighted supermatrix

		Goal	**Criteria**				**Alternatives**			
		E-policy	**RB**	**PR**	**EK**	**FS**	**E1**	**E2**	**E3**	**E4**
Goal	**E-policy**	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Criteria	**RB**	0.071	0.071	1.000	1.000	0.250	0.000	0.000	0.000	0.000
	PR	0.193	0.193	0.000	0.000	0.250	0.000	0.000	0.000	0.000
	EK	0.290	0.290	0.000	0.000	0.250	0.000	0.000	0.000	0.000
	FS	0.446	0.445	0.000	0.000	0.250	0.000	0.000	0.000	0.000
Alternatives	**E1**	0.000	0.290	0.584	0.400	0.252	1.000	0.000	0.000	0.000
	E2	0.000	0.194	0.232	0.400	0.115	0.000	1.000	0.000	0.000
	E3	0.000	0.446	0.000	0.000	0.473	0.000	0.000	1.000	0.000
	E4	0.000	0.071	0.184	0.200	0.160	0.000	0.000	0.000	1.000

Table 5The limit supermatrix

		Goal	Criteria				Alternatives			
		E-policy	**RB**	**PR**	**EK**	**FS**	**E1**	**E2**	**E3**	**E4**
Goal	**E-policy**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Criteria	**RB**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	EK	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	FS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Alternatives	**E1**	***0.351***	0.320	0.452	0.360	0.306	1.000	0.000	0.000	0.000
	E2	***0.221***	0.207	0.219	0.304	0.170	0.000	1.000	0.000	0.000
	E3	***0.280***	0.362	0.181	0.181	0.374	0.000	0.000	1.000	0.000
	E4	***0.148***	0.109	0.146	0.154	0.150	0.000	0.000	0.000	1.000

Apply the priorities obtained from ANP and resource constrained conditions according to the budget of the Taiwan's Small and Medium Enterprise Administration (SMEA) Ministry of Economic Affairs to formulate a ZOGP model to evaluate considered alternatives. The GP problem consists of four different types of decision variables: dream actualizing project (X_1), incubator center (X_2), funding assistance (X_3) and knowledge-sharing platform (X_4). x_j is the decision variables for different alternatives to be selected with various budget and resource constraints . $x_j = 1$ represents the j^{th} policy was selected, and when $x_j = 0$ represents the j^{th} module was not selected; a_{ij} represents the budget amount required for the j^{th} policy; b_i is the constraint on the available resources. According to the ANP priorities and organizational objectives and limitations, we built the ZOGP model formulation in Table 7. To achieve the goal, there are four limitations (unit is NT million dollars): (1) total three years maximum budget of NT$ 24,750 (2) avoid over the year 1 budget of NT$5,700 (3) avoid over the year 2 budget of NT$7,300 (4) avoid over the year 3 budget of NT$8,700. In addition, one flexible limitation exits. The initial total budget is set NT$20,000, which could vary up to but not beyond the total amount value of NT$24750. The available budget information for three years is shown in Table 6. The ZOGP model is solved using LINGO 8.0 software. The results are summarized in Table 8.

Table 6 Available budget for three years of entrepreneurship policy

Alternatives	Year 1	Year 2	Year 3	Available budget
X_1	\$180	\$250	\$360	\$790
X_2	\$500	\$700	\$800	\$2000
X_3	\$5000	\$6300	\$7500	\$18800
X_4	\$360	\$120	\$180	\$360

•Unit is NT million dollars

Table 7 The ZOGP model formulation

ZOGP model formulation	Goals
Minimize Z=	
$p1(d_1^+ + d_2^+ + d_3^+ + d_4^+)$,	Satisfy all limitations
$p2(0.351\times d_5^- + 0.221\times d_6^- + 0.280\times d_7^- + 0.148\times d_8^-)$,	Select highest ANP weighted alternatives
$p3(d_9^- + d_9^+)$,	Using \$200000 budget for the alternatives selected
Subject to	
$790x_1 + 2000x_2 + 18800x_3 + 360x_4 + d_1^- - d_1^+ = 24750$	Avoid over Year 1-3 total budget
$180x_1 + 500x_2 + 5000x_3 + 60x_4 + d_2^- - d_2^+ = 5700$	Avoid over Year 1 budget
$250x_1 + 700x_2 + 6300x_3 + 120x_4 + d_3^- - d_3^+ = 7300$	Avoid over Year 2 budget
$360x_1 + 800x_2 + 7500x_3 + 180x_4 + d_4^- - d_4^+ = 8700$	Avoid over Year 3 budget
$x_1 + d_5^- = 1$	Select X 1
$x_2 + d_6^- = 1$	Select X 2
$x_3 + d_7^- = 1$	Select X 3
$x_4 + d_8^- = 1$	Select X 4
$360x_1 + 800x_2 + 18800x_3 + 360x_4 + d_9^- - d_9^+ = 20($	Avoid over or under expected total budget
$d_i^+ \geq 0$, $d_i^- \geq 0$ i=1, 2, 3, …, 9	
$x_j = 0$ or 1 j=1, 2, 3, 4	

Table 8 The ZOGP model solution results

$X_1 = X_2 = X_3 = 1$, $X_4 = 0$, $d_1^- = 3160$, $d_1^+ = 0$, $d_2^- = 20$, $d_2^+ = 0$, $d_3^- = 50$, $d_3^+ = 0$, $d_4^- = 40$, $d_4^+ = 0$, $d_5^- = 0$ $d_6^- = 0$, $d_7^- = 0$, $d_8^- = 1$, $d_9^- = 0$, $d_9^+ = 1590$

Discussion

In the example, results of DEMATEL show that "Financing and business support (FS)" have the highest (D-R) value and is a powerful criterion. 'Financing and business support' playa the important role in evaluating entrepreneurship policy and has the great influence on "RB", "PR" and "EK". On the other hand, "Entrepreneurship knowledge (EK)" has negative and the lowest value of (D-R). The results represents that the evaluating criteria of the policy should emphasize the financing and business support. The result of the ANP phase are the priority weights for each evaluating criteria and alternative, namely W^{ANP}(E1, E2, E3, E4)= (0.351, 0.221, 0.280, 0.148). Table 5 shows that the result of ANP indicates the "Dream actualizing project" has the highest priority of alternatives which is followed by "Financing assistance", "Incubator center" and "Knowledge-sharing platform". The final results of ZOGP show that SMEA will select three alternatives (Dream actualizing project, Financing assistance and Incubator center) under the budget constraints. If the decision-makers will consider the possibility of various scenarios, the resources reallocation or priorities should be changed and the results may be different. Therefore, a scenario analysis is important for decision making. The study proposed scenario analysis to help decision makers in evaluating the policies.

The scenario analysis is performed in two scenarios with revised options according to the variation in ANP weights and priority changes of the policies. First, Table 8 illustrates four scenarios which were manipulated in four different ANP priority weights with the constant resource usages and limitations as the original illustration represented. The illustration is the scenario 1 in Table 9. In four scenarios of different ANP priority weights, the alternatives with the three higher ANP weights would be always selected. Without a doubt, the priorities of the ANP weights were a critical consideration with the constant resource usages and limitations when policy makers will evaluate the entrepreneurship policy. Secondly, we changes the priorities of six scenarios, the original illustration is the scenario 1 in Table 10. In scenario 2 and scenario 3, the optimal solution is to select four alternatives due to the first priority of selecting highest ANP weighted alternatives. However, in scenario 3 to 5 the optimal solution is to select three alternatives (X1, X3 and X4) and show surplus resources.

Table 9 Scenarios analysis of variation in ANP weights

ANP weights, solutions and resources	1	2	3	4
ANP weights				
X_1	0.351	0.221	0.280	0.148
X_2	0.221	0.280	0.148	0.351
X_3	0.280	0.148	0.351	0.221
X_4	0.148	0.351	0.221	0.280
Optimal Solution of selection	X_1	X_1	X_1	X_2
	X_2	X_2	X_3	X_3
	X_3	X_4	X_4	X_4
Result of consumed resources of scenario	1	2	3	4
Total	3160	21600	4800	3590
Year1	20	4960	460	140
Year2	50	6230	630	180
Year3	40	7360	660	220
Flexible budget	(1590)	16850	50	11160

Table 10 Scenarios analysis of priority changes

Priority, solutions and solution	1	2	3	4	5	6
Priority change						
	p1	p1→p2	p1→p2	p1→p3	p1→p3	p1→p1
	p2	p2→p1	p2→p3	p2→p2	p2→p1	p2→p3
	p3	p3→p3	p3→p1	p3→p1	p3→p2	p3→p2
Optimal Solution of selection	X_1	X_1	X_1	X_1	X_1	X_1
	X_2	X_2	X_2	X_3	X_3	X_3
	X_3	X_3	X_3	X_4	X_4	X_4
		X_4	X_4			
Result of consumed resources of scenario	1	2	3	4	5	6
Total	3160	2800	2800	4800	4800	4800
Year1	20	(40)	(40)	460	460	460
Year2	50	(70)	(70)	630	630	630
Year3	40	(140)	(140)	660	660	660

Flexible budget	(1590)	(1950)	(1950)	50	50	50

CONCLUSIONS

The evaluation of entrepreneurship policy is a kind of MCDM problem which requires a large number of complex elements considered as evaluation criteria. This paper integrates the DEMATEL, ANP and ZOGP methods to form a hybrid model to assist policy makers to solve the problem of selection decisions and evaluation of entrepreneurship policy. In particular, the DEMATEL method can demonstrate the contextual relation among the elements in which the numeral represents the strength of influence and the ANP method can deal with the interdependences among elements (Wu, 2007). Considering the priorities of the alternatives is not enough, we employ ZOGP to select the optimal alternatives under the resource constraints.

At the same time, we provide a practical application of the evaluation for entrepreneurship policy in Taiwan for meeting the goal of the policy. The results of the evaluation are selecting three alternatives (Dream actualizing project, Financing assistance and Incubator centers) under the budget constraints. In addition, two types of scenario analysis based on the different ANP weights and priorities change is to provide an insight to decision makers when the conditions are changed. Finally, the hybrid model is the first time to be applied to policy evaluation and it helps the policy makers to make decisions through more scientific techniques and taking account of interdependent criteria and limited resources.

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A QUALITY LOSS APPROACH FOR AIRLINE SERVICE FAILURE ANALYSIS

Pao-Tiao Chuang, National University of Kaohsiung, Taiwan.
ptchuang@nuk.edu.tw

ABSTRACT

This paper proposes an approach that performs airline service failure analysis from the perspective of quality loss. In the paper, the quality requirements and the potential failure modes of airline service are first generated. Then, service quality evaluation is performed and the quality loss for each quality requirement is computed. Finally, the consolidated quality loss for each failure mode is computed according to a correlation matrix that relates each failure mode to the corresponding service quality requirement. The severity of each failure mode can be identified based on the consolidated quality loss. Empirical data are collected through questionnaire surveys of airline customers in Taiwan. Results show that the seven most severe failure modes include: cabin crew failures, disregard of cultural differences of passengers, managerial failures, poor ability to deal with contingencies, insufficient expertise of and/or inappropriate attitude from flight attendants, passengers adversely affecting each other, and inadequate number of cabin crew. This provides the airline companies the directions for taking either preventive action that eliminate the occurrence of these failures or recovery action that compensate and alleviate the effects of these failures to enhance airline service quality.

Keywords: Airline Service; Service Quality; Service Failure; Quality Loss.

INTRODUCTION

Service quality is defined as the extent to which the delivered service level matches customer expectations (Grönroos, 1982; Lewis and Booms, 1983). Delivering quality service means conforming to customer expectations on a consistent basis. Thus, only the customer can truly define service quality in the airline industry, and passenger perceptions of service quality play a key role in the success of an airline (Butler and Keller, 1992). In terms of airline service quality, the SERVQUAL proposed by Parasuraman et al. (1988) is believed to be one of the best models for evaluating customer expectations and perceptions (Pakdil and Aydin, 2007). It has also been adopted as a valid and reliable instrument for measuring airline service quality (Gilbert and Wong, 2003; Park et al., 2004; Gursoy et al., 2005; Liou and Tzeng, 2007; Pakdil and Aydin, 2007; Lu and Ling, 2008).

Many airline companies are looking toward service quality to distinguish their product and thus achieve a competitive edge, because the competitive advantage of these companies lies in their service quality as perceived by customers (Liou and Tzeng, 2007; Netjasov and Janic, 2008). Literatures have also suggested that airline service quality is one of the most critical factors that influence a passenger's selection of airlines. Significant relationships exist among reputation, service, and customer retention (Ostrowski et al., 1993; Truitt and Haynes, 1994; Tiernan et al., 2008). Therefore, providing high-quality service to passengers is important for many airlines, because it maintains customer patronage, market share and, ultimately,

profitability.

Despite its importance and advantage in measuring airline service quality and setting up zero-defect as the desired objective for most of the airline companies, service failures still happen occasionally. Similar to service quality and satisfaction, it is the customers' perception that determines whether a service failure has occurred (Goldstein *et al.*, 2002; Weber and Sparks, 2004). Thus, a service company must understand what the customers really need and then delivered its service accordingly. Nevertheless, Halstead et al. [1996] have mentioned that nothing is better than performing a service to satisfy customers the first time, while nothing is worse than failing to detect a problem or obtain information from an unsatisfied customer. Therefore, a systematic approach, that can identify and prioritize the critical service failure modes with the corresponding risks as well as required preventive or recovery actions, is essential to enhance the service quality.

This paper aims to perform the airline service failure analysis from the perspective of service quality loss. In the paper, the quality requirements of airline service are first generated by synthesizing related literature and interviewing airline customers. The service quality evaluation that measures the discrepancy between customer perceptions and customer expectations of each service quality requirement is performed. The quantitative quality loss for each quality requirement is computed when customer perceptions of that requirement are lower than customer expectations. In addition, potential failure modes are determined by analyzing airline service blueprints. Then, a correlation matrix, that identifies the adverse effects of each failure mode to the corresponding service quality requirement, is constructed. Finally, the consolidated quality loss for each service failure mode is computed according to this correlation matrix. The most severe failure modes can be identified based on the consolidated quality loss.

AIRLINE SERVICE QUALITY

Service quality is defined as the extent to which the delivered service level matches customer expectations (Grönroos, 1982; Lewis and Booms, 1983). Delivering a quality service means conforming to customer expectations on a consistent basis. Perceived service quality can be evaluated as the degree and direction of discrepancy between consumer perceptions and customer expectations regarding a particular service provided by the service company. Thus, only the customer can truly define service quality in the airline industry, and so passenger perceptions of service quality play a key role in the success of an airline (Butler and Keller, 1992).

In airline service, the SERVQUAL proposed by Parasuraman *et al.* (1988) is adopted as the best model for evaluating customer expectations and perceptions (Pakdil and Aydin, 2007). Moreover, it has been proven as a valid and reliable instrument for measuring airline service quality (Gilbert and Wong, 2003; Park et al., 2004; Gursoy et al., 2005; Liou and Tzeng, 2007; Pakdil and Aydin, 2007; Lu and Ling, 2008). By synthesizing these various studies and interviewing airline customers in Taiwan, this study identifies 26 quality requirements of airline service. As illustrated in the lists below, these quality requirements cover all processes of airline service, including ticketing and booking, check-in, boarding and on-board service, and arrival, as well as core service requirements.

Ticketing and Booking:

Q1. Convenient flight schedules;
Q2. Attitudes of ticketing servers;
Q3. Concise procedures and correctness of booking;
Q4. Reasonable airfare;
Q5. Clear description for discount or premium ticket.

Check-in:

Q6. Well-dressed and neat appearance of ground servers;
Q7. Convenient baggage check-in;
Q8. Indeed passing the baggage receipts to customers;
Q9. Fast check-in.

Boarding and On-Board Service:

Q10. Safety;
Q11. On-time schedule;
Q12. Cleanliness of cabin;
Q13. Comfortable seats;
Q14. Newspaper, magazines and entertainment facilities;
Q15. In-flight food and drink;
Q16. Modernized or computerized equipment;
Q17. Well-informed and well-dressed flight attendants;
Q18. Personal attention to passengers and prompt response to passenger requests;
Q19. Real-time reporting of flying information to passengers.

Arrival:

Q20. Convenient baggage claim protocol;
Q21. Actions on baggage loss.

Core Service:

Q22. The airline company is dependable;
Q23. The airline company gives passengers individual attention, understands passenger needs, and has the best interests of passengers at heart;
Q24. The airline company truly carries out what it promises to passengers;
Q25. Responsible recovery actions are taken based on passenger complaints;
Q26. All services are accurate and prompt.

QUALITY LOSS COMPUTATION

Service quality is a function of customer satisfaction. If customers are not satisfied with a service, they tend to evaluate service quality negatively. In this situation, perceptions are lower than expectations for that service quality requirement, thus potentially signifying quality loss. A larger discrepancy between perceptions and expectations indicates greater quality loss.

To evaluate airline service quality, a quality loss function for each quality requirement is used, as shown in Equation (1).

$$L(y_j) = \begin{cases} k_j \cdot (y_j - m_j)^2 & for \quad y_j < m_j \\ 0 & for \quad y_j \geq m_j \end{cases}, \qquad (1)$$

where,

$L(y_j)$ = Quality loss incurred due to customer dissatisfaction with the j[th] service quality requirement; j =1, 2, …, 26.

k_j = Coefficient of quality loss for the j[th] service quality requirement; j =1, 2, …, 26.

Note that, to acquire k_j, this paper uses a questionnaire to investigate the extent of customer loss when customers are not satisfied the j[th] service quality requirement.

y_j = The aggregate customer perception of the j[th] service quality requirement; j =1, 2, …, 26.

m_j = The aggregate customer expectation of the j[th] service quality requirement; j =1, 2, …, 26.

$(y_j < m_j)$ represents the extent to which customer perceptions are lower than customer expectations for the j[th] service quality requirement.

To collect data for service quality evaluation and compute quality loss, a questionnaire was designed using a seven-point Likert scale to investigate customer perceptions and expectations, as well as the probability of customer loss when customers are not satisfied with each of the service quality requirements. In the survey, 1 represents a very low perception or expectation, while 7 represents a very high service quality evaluation. In addition, 1 indicates that the probability of customer loss is very low, while 7 represents that this probability is very high. The survey was conducted in October 2007 at Taoyuan International, Taipei Songshan, and Kaohsiung International Airports in Taiwan. Overall, 310 of 500 questionnaires were collected. After discarding those identified as incomplete or non-random, 284 were usable for the purposes of this study.

Using Equation (1), the quality loss $L(y_j)$ incurred from each quality requirement can be computed and the results are shown in Table 1. According to Table 1, the top seven quality requirements having the highest quality losses in descending order are: “Q21.Actions on baggage loss”, “Q13.Comfortable seats”, “Q25. Responsible recovery actions are taken based on passenger complaints”, “Q15.In-flight food and drink”, “Q20.Convenient baggage claim”, “Q23.The airline company gives passengers individual attention, understands passenger needs, and has the best interests of passengers at heart”, and “Q4.Reasonable airfare,’ respectively. This means that the incurred quality loss with regard to these quality requirements could grow to be larger if these requirements are not perceived by customers as satisfied. Thus, airline companies should invest more resources in these requirements in order to improve customer perceptions and, through this, to increase customer satisfaction and decrease quality loss.

Table 1. Results of Quality Loss Analysis

Service Process	Service Quality Requirement	Expectation (m_j)	Perception (y_j)	Discrepancy ($y_j - m_j$)	Coefficient of Quality Loss (k_j)	Quality Loss ($L(y_j)$)	Order of Quality Loss
Ticketing and Booking	Q1.Convenient flight schedules	4.950	4.475	-0.475	4.596	1.037	14
	Q2.Attitudes of ticketing servers	5.171	4.852	-0.319	4.655	0.474	24
	Q3.Concise procedures and correctness of booking	5.135	4.743	-0.392	4.656	0.715	20
	Q4.Reasonable airfare	4.601	4.059	-0.542	4.926	1.447	7
	Q5.Clear description for discount or premium ticket	4.727	4.270	-0.457	4.480	0.937	18
Check-in	Q6.Well-dressed ground servers	5.123	4.791	-0.332	4.368	0.481	23
	Q7.Convenient baggage check-in	5.091	4.728	-0.364	4.583	0.607	21
	Q8.Indeed passing the baggage receipts to customers	5.015	4.882	-0.133	4.496	0.079	26
	Q9.Fast check-in	5.051	4.551	-0.500	4.754	1.190	8
Boarding and On-Board Service	Q10.Safety	5.508	5.055	-0.453	5.287	1.085	12
	Q11.On-time schedule	5.386	4.932	-0.454	4.874	1.004	16
	Q12.Cleanliness of cabin	5.435	4.968	-0.467	4.866	1.062	13
	Q13.Comfortable seats	5.282	4.584	-0.698	4.867	2.370	2
	Q14.Newspaper, magazines and entertainment facilities	4.822	4.491	-0.332	4.211	0.463	25
	Q15.In-flight food and drink	5.027	4.388	-0.639	4.486	1.832	4
	Q16.Modernized or computerized equipment	4.959	4.477	-0.482	4.331	1.006	15
	Q17.Well-informed and well-dressed flight attendants	5.271	4.850	-0.421	4.543	0.804	19
	Q18.Personal attention to passenger and prompt responses to passenger requests	5.246	4.753	-0.493	4.794	1.164	9
	Q19.Real-time reporting of flying information to passengers	5.228	4.897	-0.331	4.687	0.514	22
Arrival	Q20.Convenient baggage claim protocol	5.127	4.551	-0.577	4.658	1.548	5
	Q21.Actions on baggage loss	5.177	4.472	-0.705	5.065	2.520	1
Core Service	Q22.The airline company is dependable	5.239	4.760	-0.479	4.944	1.133	10
	Q23.The airline company gives passengers individual attention, understands passenger needs, and has the best interests of passengers at heart	5.238	4.674	-0.564	4.787	1.524	6
	Q24.The airline company carries out what it promises to passengers	5.196	4.746	-0.450	4.913	0.995	17
	Q25.Responsible recovery actions are taken based on passenger complaints	5.188	4.523	-0.665	5.064	2.241	3
	Q26.All services are accurate and prompt	5.243	4.767	-0.475	4.958	1.121	11

AIRLINE SERVICE FAILURES

A service failure occurs when customers' expectations are not met [Mueller *et al.*, 2003; Weber and Sparks, 2004]. Service failures have negative impacts on service quality and customer satisfaction. That is, when customers are not satisfied with the service, there must be discrepancies resulting from the occurrence of some particular service failures. Besides, if customers are not satisfied, they are likely to complain about the service quality. Major complaining issues in airline service involve flight problem, over-booking, reservation/ticketing/boarding, fares, refund, baggage, on-board service, disability, and advertising complaints (Gursoy *et al.*, 2005). As long as the passengers are satisfied with the service quality, they are less likely to have any intention to complain.

Based on analysis of service blueprints and observations of airline practices, 23 potential failure modes of airline service are listed below. These potential failure modes cover all processes of airline service, including ticketing and booking, check-in, boarding and on-board service, and arrival, as well as core service requirements.

Ticketing and Booking:

F1. Inappropriate attitudes from ticketing servers;
F2. Inconvenient online booking process;
F3. Over-booking;
F4. Insufficient capacity (e.g., flight schedules, number of seats).

Check-in:

F5. Check-in service failures (e.g., seating, baggage tag);
F6. Passenger personal preferences are not satisfied;
F7. Check-in flow is slow or frustrating.

Boarding and On-Board Service:

F8. Passengers not boarded on-time;
F9. Disregard of cultural differences of passengers;
F10. Cabin crew failures;
F11. Inadequate number of cabin crew;
F12. Insufficient supply of food and drink;
F13. Poor cabin facilities (e.g., entertainment);
F14. Passengers adversely affecting each other;
F15. Insufficient expertise of and/or inappropriate attitude from flight attendants;
F16. Passenger needs not satisfied (e.g., food, drink, magazine, entertainment).

Arrival:

F17. Insufficient flight transfer information;
F18. Inefficient baggage claim;
F19. Baggage loss.

Core Service:

F20. Maintenance or repair failures;
F21. Poor ability to deal with contingencies;
F22. Poor actions regarding customer complaints;
F23. Managerial failures (e.g., air route planning, pricing, flight scheduling).

IDENTIFYING SEVERE FAILURE MODES

When customers are not satisfied with the service quality, there must be some particular service failures occurred in certain segment of the service processes or core service. To identify how each service failure mode impacts the quality requirement, a correlation matrix that show the relationship between each failure mode and the corresponding quality requirement is constructed as Table 2. Note that in each cell of the matrix, "1" represents that the failure mode and the corresponding quality requirement are correlated, while a blank entry represents no correlation.

To quantitatively identify the risk of particular types of failure, the consolidated quality loss for each potential failure mode is computed using Equation (2); the results are shown in the right-most column of Table 2.

$$TL_i = \sum_{j=1}^{26} r_{ij} \cdot L(y_j), \qquad (2)$$

where,

TL_i = The consolidated quality loss for the i^{th} potential failure mode; i =1, 2, …, 23。

r_{ij} =The relationship between the i^{th} potential failure mode and the j^{th} quality requirement. r_{ij} =1 if a correlation exists; r_{ij} =0 if the correlation doesn't exist, where i =1, 2, …, 23, and j =1, 2, …, 26.

From Table 2, the seven most severe failure modes based on the consolidated quality losses in descending order are: "F10.Cabin crew failures", "F9.Disregard of cultural differences of passengers", "F23.Managerial failures (e.g., air route planning, pricing, flight scheduling)", "F21.Poor ability to deal with contingencies", "F15.Insufficient expertise of and/or inappropriate attitude from flight attendants", "F14.Passenger adversely affecting each other", and "F11.Inadeguate number of cabin crew." This indicates there could be higher losses with more severe effects if any one or more of these service failures occur. Thus, either preventive action that eliminate the occurrence of these severe failures or recovery action that compensate and alleviate the effects of these failures need be taken in real time to enhance the quality assurance of airline service.

CONCLUSIONS

Airline service quality is one of the most critical factors that influence passenger decisions regarding airline selection. Providing high-quality service to passengers is important for many airlines, because it helps to maintain customer patronage, market share and, ultimately, profitability. Though airline companies look toward service quality as an opportunity to achieve a competitive edge, service failures do happen occasionally. Therefore, a systematic approach that can identify and prioritize more severe service failures with corresponding risks is essential to enhance the quality assurance of airline service.

This paper performed the airline service failure analysis from the perspective of service quality loss. Based on this, the most severe failure modes can be identified for taking required action in real time to enhance quality assurance. Results show that the seven most severe failure modes include: cabin crew failures, disregard of cultural differences of passengers, managerial failures (e.g., air route planning, pricing, flight scheduling), poor

Table 2. Results of Consolidated Quality Loss

		Service Quality Requirements																									
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Consolidated Quality Loss (TL_i)
	$L(y_j)$	1.037	0.474	0.715	1.447	0.937	0.481	0.607	0.079	1.190	1.085	1.004	1.062	2.370	0.463	1.832	1.006	0.804	1.164	0.514	1.548	2.520	1.133	1.524	0.995	2.241	1.121	
Service Failure Mode	F1		1		1		1																					2.402
	F2			1																								0.715
	F3	1				1																						1.947
	F4	1																							1	1		4.273
	F5						1	1	1															1	1			3.686
	F6			1	1														1					1				4.850
	F7									1																		1.190
	F8											1											1		1		1	4.253
	F9													1	1	1		1						1	1	1		10.229
	F10										1			1	1	1				1				1	1	1		11.024
	F11										1	1	1						1				1				1	6.569
	F12															1									1			2.827
	F13												1	1	1		1											4.901
	F14												1	1												1	1	6.794
	F15																	1	1					1	1	1	1	7.849
	F16													1	1	1			1									5.829
	F17	1										1												1				3.565
	F18							1	1												1						1	3.355
	F19							1	1												1	1	1					5.887
	F20										1	1		1	1								1					6.055
	F21									1		1										1		1		1		8.479
	F22						1																		1	1		3.717
	F23	1			1	1	1			1													1	1	1		1	9.865

(Note: In each cell, "1" represents the failure mode and the corresponding quality requirement has correlation, while blank represents no correlation.)

ability to deal with contingencies, insufficient expertise of and/or inappropriate attitude from flight attendants, passengers adversely affecting each other, and inadequate number of cabin crew. This indicates that there could be higher losses and more severe effects if any of these failure modes occur.

Various service industries, such as retailing, railway service, distribution center, and banking service, can also use the proposed approach to identify the severity of each failure mode and pursue quality assurance. Future research may adopt a fault-tree analysis to exploit the root causes of severe failures and thus take the actions necessary to enhance preventive service quality.

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SURVEY OF THE SHADOW ECONOMY IN SLOVENIA: THE DEMAND SIDE OF THE HOUSEHOLDS

Dr. Bojan Nastav, University of Primorska
bojan.nastav@fm-kp.si
Dr. Štefan Bojnec, University of Primorska,
stefan.bojnec@fm-kp.si
Dr. Ivo Lavrač, University of Ljubljana,
ivo.lavrac@ef.uni-lj.si

ABSTRACT

In the paper we deal with the phenomenon of the shadow economy, focusing on the demand side of households. We try to provide answers to three main questions. Firstly we propose a schematic approach to show the interaction of shadow economy (defined as the productive activities whose products are legal but the production itself is deliberately concealed from authorities) and other connected areas, which are sometimes regarded as synonyms, but without proper ground to do so. Secondly, based on the survey on the shadow economy in Slovenia we state that the demand side is an autonomous side of the shadow economy, yet to a greater extent in line with the production side with respect to participants and a somewhat lower degree with respect to the goods/services purchased in the shadow economy. Finally, we propose that the policy of reducing the shadow economy is better to be focused on the production side in the sense of improving entrepreneurial environment and governments' efforts to channel entrepreneurial activities from the shadow economy into the official one. This is because the participants, carriers of work and consumption, vary only slightly on both sides (supply and demand) of the shadow economy and by gradually decreasing incentives for either side, both, the supply and demand sides of the shadow economy will reduce.

INTRODUCTION

The phenomenon of the shadow economy is inevitably present in every society. Therefore, this has to be integrated into our policy-making process and in comparison in time and/or place. In order to do that in a proper way, the shadow economy has to undergo research. The literature so far offers a wide range of studies on the shadow economy, focusing on virtually all aspects: the definition, causes, consequences, measuring issues, and how to fight the shadow economy (e.g. Feige and Ott (1999), Schneider and Enste (2002), Schneider (2004), Williams (2004)). Yet many questions still remain. Among them one can find questions of consistent definition, the best way of measuring/estimating the size, and how to approach the shadow economy.

Of all the research being conducted so far the majority remains on the supply side of the

shadow economy, studying the size of hidden production, who and why engages in such activities. On the other hand the demand side of the shadow economy has been studied only in limited scope (e.g. Jon Isachsen and Strøm (1985), Kałaska and Witkowski (1999), Mantarova (2000), European Commission (2004; 2007), Wallace, Haerpfer and Latcheva (2004)). But there are few reasons to believe that the shadow economy is supply driven. Rather, one can more easily picture the situation where no demand for the shadow economy goods/services would also bring hard time for the shadow economy producers to sell their products. This is why we focus on the demand side of the shadow economy in Slovenia, yet do not neglect the important findings of the other, supply (or production) side of the shadow economy, which has been identified via the survey of the shadow economy in Slovenia. Furthermore we try to establish the link between the supply and demand sides of the shadow economy in the light of proposing policy actions to tackle the shadow economy. In this manner we propose that the shadow economy has very similar sides of supply and demand in terms of their participants and the goods exchanged. Therefore we also propose that the policies aiming at reducing the shadow economy can target the production side and will reduce the demand side of the shadow economy as well – due to similar carriers of the work, i.e. participants that either work or purchase in the shadow economy.

The first step in practically every research on shadow economy is its definition. There are various points of view defending various definitions, yet a commonly accepted one by the whole research community has not yet been reached. This may be the case of lack of will to do so or the shear knowledge of the fact that having the unique definition might change the studies only marginally. Nevertheless, we propose to solve the definition part of the shadow economy once and we start with the research with the definition as well. We propose the scheme how the shadow economy may interact/overlap with other, commonly used terms for defining such a phenomenon. This is indicated in section two. Section three concentrates on survey of the shadow economy in Slovenia as the main data source. It also reveals few main points of the supply side of the shadow economy in Slovenia, based on this data source. In section four we present the demand side of the shadow economy in Slovenia with respect to participants, amount of money spent and the goods purchased in the shadow economy. Next section, section five, provides few policy propositions to fight the (negative consequences of the) shadow economy with more emphasis on the demand side of the shadow economy. Section six concludes.

DEFINING THE SHADOW ECONOMY

The shadow economy is with respect to definition a rather problematic phenomenon. Problems arise not only because of differences in definitions of the studied area, but also due to different terms used. Such problematic nature of the shadow economy arises when comparison, either in time or in place is being made. The combinations (of different terms and definitions) thus offer a variety of options for flaw comparison. Although taking the same quantities is essential for proper comparison, with the shadow economy the problem becomes

less evident. This is the case because of the practical fact: by definition, it is not possible to measure the unmeasured, which means that however accurate the definition is, there is a realistic possibility that it will be measured only partially. Besides, although there are differences in definitions among researchers, from practical point of view the majority of time the phenomenon is more or less equally defined.

Nevertheless, we propose to solve the definition part of the shadow economy. We are aware of the fact that the borderline between different terms is in real life hard to set. This means that although we have the proper definition on the paper, once the measurement takes place it is not possible to separate some activities from the shadow economy. Despite this, some of the terms cannot be used as synonyms as is sometimes proposed.

Bellow we only briefly explain these different terms. For the guideline with assessing their suitability for shadow economy we use the production or production boundary as defined by the System of National Accounts SNA 1993 (or European Union equivalent European System of Accounts ESA 1995): every activity under supervision and responsibility of institutional unit that uses the inputs of work and capital, and goods and services to produce goods and services (ESA 1995, 1996, p. 37).

Having the production boundary in mind, we propose the following definition of the shadow economy: all productive activities, whose goods and services are legal, but the activity itself is deliberately concealed from authorities, usually to make financial gains (e.g. tax avoidance, non-compliance with certain regulations and standards).

There have been attempts to bring together all the unreported/hidden economic activities that complete the officially measured production within the production boundary. In this manner the OECD (in collaboration with other institutions) presented a handbook on Measuring the Non-observed Economy (OECD, 2002). The problem still remains, with respect to the shadow economy, that even though the non-observed economy (NOE) is divided into five subgroups, they occasionally overlap and even more significantly, turn to non-shadow economy activities. And thus cannot be used as the synonyms.

One of the frequently assumed shadow economy productions is the household production for own final use. This comprises all the production carried out by the household unit and in this manner some of the activities are outside the production boundary (i.e. “do it yourself” activities) which means such a production cannot be used as the synonym for (all of) the shadow economy.
Next, often misunderstood as the shadow economy, is the informal sector. This in general applies to the less developed countries, yet the main reason against using it as the synonym of the shadow economy is the fact, that it excludes the agriculture activities, whereas they can be a significant part of the shadow economy.

Tax evasion is another field normally strongly linked to the shadow economy. Although the shadow economy has in its roots hiding for not paying taxes, not all of the shadow economy is tax evasion (i.e. not complying with certain regulation) and not all of the tax evasion is not shadow economy (i.e. strictly financial transactions are not within the production boundary and thus not in the shadow economy as well).

Illegal (black) economy is the one which is in total (production/distribution and the products themselves) illegal, which makes it different from the shadow economy, which is only partially illegal.

Undeclared work refers to the work that is carried out for otherwise legal production but without declaring it (which makes it illegal) (European Commission, 2004). In this respect this can be used as the synonym for the shadow economy. In Slovenia there is a similar term that covers all the undeclared work (*work on black*), regardless of the legality of production itself, which makes it less suitable for the synonym of the shadow economy, yet in practice the overlapping is nearly perfect.

Underground economy is another frequently used term and also declared in the NOE subgroups. It is defined as the productive economic activities that are legal but hidden from public authorities with the aim of not paying taxes or social security contributions, and/or complying with regulations. And this is exactly the definition we have used for the shadow economy, thus making the shadow economy and underground economy complete synonyms, whereas with the other terms caution is well needed.

To sum up the brief discussion of commonly used terms, we propose the scheme how the shadow economy may interact/overlap with them. This is depicted in Figure 1, where one needs to have in mind that it is not proportional scheme but merely used for showing the relation between different terms.

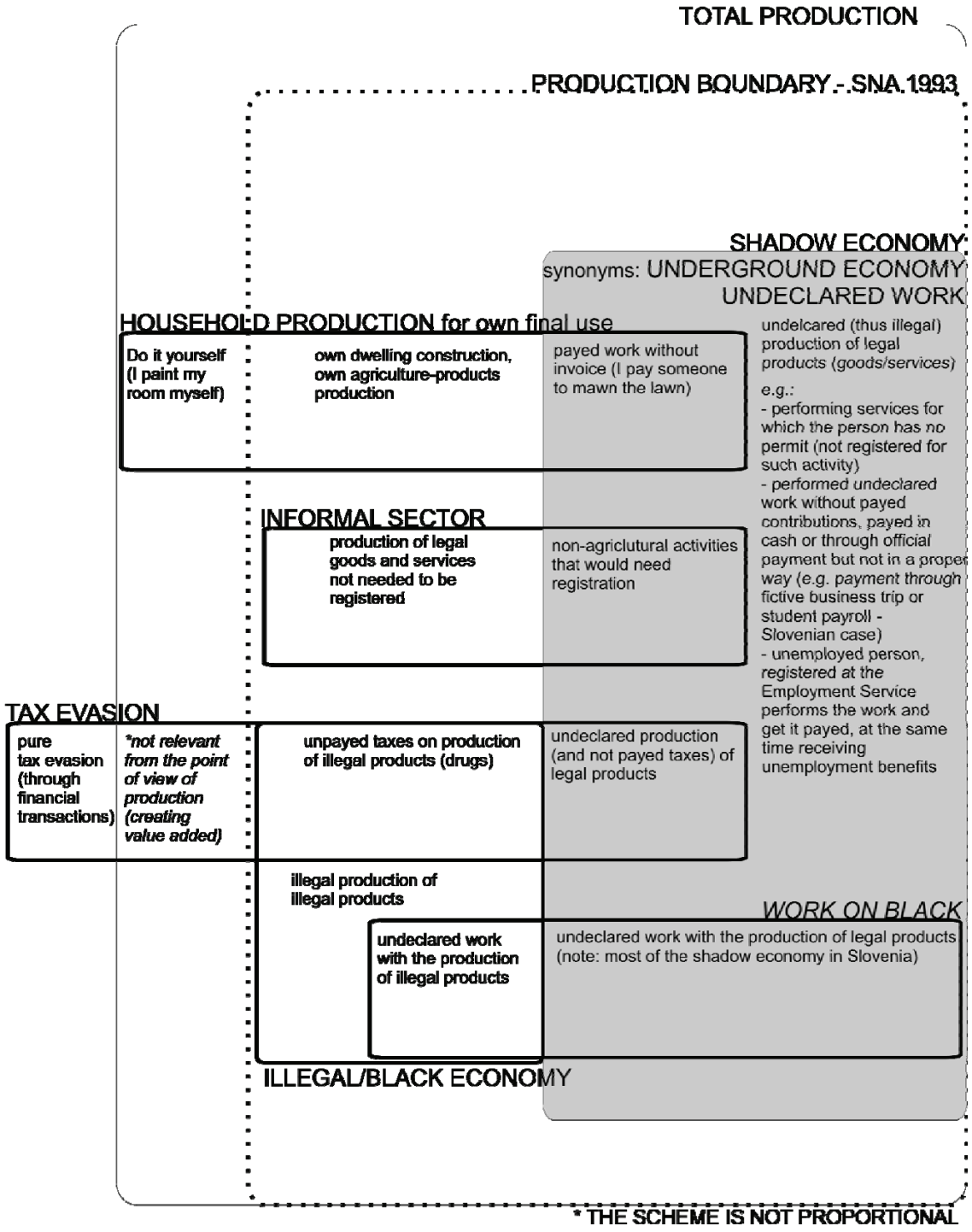

Figure 1: The scheme of the shadow economy and other terms

SURVEY OF THE SHADOW ECONOMY IN SLOVENIA

There are various methods of measuring/estimating the shadow economy (which is measured as the percentage of the GDP in an economy) (see for instance Schneider and Enste (2002)). Some of them are more reliable than others and we believe that direct methods such as surveys are the most appropriate to study the phenomenon in depth. With this respect this paper relies on the data gathered from a survey of the shadow economy in Slovenia.

The survey was carried out in April 2007 among nearly 5000 inhabitants in Slovenia aged 15 and above, stratified over the twelve statistical regions in Slovenia. Questionnaires were sent out via post. The data were obtained from the Central Registry of Population in Slovenia, which is under the supervision of the Ministry of the Interior. We have got 890 returned questionnaires which we believe is rather a success for such a delicate theme.

We have checked whether the sample was representative of the population with respect to five variables: gender, education, age, status, and region. Accordingly we have somewhat weighted the sample to obtain more reliable results (this is presented in Appendix).

Survey of the shadow economy in Slovenia revealed that 11,2 percent of the population works in the shadow economy. Normally, the income from the shadow economy presents less than 10 percent of what they earn in the official economy, using the weighted average the income from the shadow economy represents astonishing 43,4 percent of the officially reported incomes (33,5 do 53,3 percent in a rather wide 95-percent confidence interval). However, one needs to have in mind that shadow economy is usually expressed in terms of percentage of GDP, thus this figure has to be modified accordingly. Taking into account the net incomes of the households in Slovenia in 2007 which sum up to 35,9 percent of GDP (GDP, Yearly Data, 2007 and Rapid Report, No. 72, 2007, p. 3), and assuming equal distribution of incomes in the shadow and official economies, the shadow economy in Slovenia in 2007 represents 15,6 percent of GDP (12 to 19,1 percent of GDP in a 95-percent confidence interval).

Furthermore, the results reveal that above 61 percent of the money, earned in the shadow economy, is spent in the official economy. Only 17 percent is returned to the shadow economy for further spending and slightly above one fifth of the money, earned in the shadow economy is destined for savings. This points to the fact that nearly 80 percent of the shadow-economy earned money is spent for current living and therefore the shadow economy is not there for accumulating wealth but rather getting through the month more easily.

Activities in the shadow economy take place in various industries, prevailing are agriculture (A) (almost 17 percent of all the shadow economy activities), manufacturing (D), construction (F), wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (G), hotels and restaurants (H) (all between 10 and 13 percent), vivid are also other community, social and personal service activities (O, over 16 percent) – see table 1. Amongst others, important role in the shadow economy plays also the education (M) with over 6 percent of all the shadow economy activities.

Table 1: Shadow economy by activity (total and by gender)

Activity	Shadow economy	Male	Female
A	16,8	13,8	21,5
B	2,9	2,0	4,7
C	0,0	0,0	0,0
D	12,9	14,1	10,9
E	3,2	5,1	0,0
F	10,1	15,5	1,4
G	12,1	12,2	11,6
H	11,4	8,4	16,1
I	0,6	0,8	0,0
J	0,6	0,9	0,0
K	1,3	1,2	1,3
L	0,0	0,0	0,0
M	6,7	5,1	9,8
N	2,9	1,3	6,0
O	16,7	19,5	12,4
P	1,8	0,2	4,4
Total	**100,0**	**100,0**	**100,0**

Note: A – Agriculture, Hunting and Forestry, B – Fishing, C - Mining and Quarrying, D – Manufacturing, E - Electricity, Gas and Water Supply, F – Construction, G – Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods, H – Hotels and Restaurants, I – Transport, Storage and Communications, J – Financial Intermediation, K – Real Estate, Renting and Business Activities, L – Public Administration and Defence; Compulsory Social Security, M – Education, N – Health and Social Work, O – Other Community, Social and Personal Service Activities, and P – Private Households with Employed Persons.

Source: Survey of shadow economy.

From the survey we can also conclude that on average men are more prone to the shadow-economy activities, yet different conclusions can be reached when checking this issue on an activity level (see table above). Furthermore, younger (especially those between 26 and 35 years of age) and those that are unemployed (and not registered at the Employment Service) are more present in the shadow economy, whereas education plays no significant role when it comes to comparing the activities in official and shadow economy.

THE DEMAND SIDE OF THE SHADOW ECONOMY

The shadow economy has similar rules as the official economy. There is a supply from people working in the shadow economy (which was briefly presented for Slovenia in the previous section). This supply or production side of the shadow economy is typically the one that is being studied. And prosecuted by law. There are laws that imply penalties for those working in the shadow economy, employing workforce undeclared, not issuing receipts – all with the aim of avoiding paying taxes to proper authorities. On the other hand, restrictions/penalties for those that act on the demand side are much less harsh. One side of the story is the

relatively higher effort needed to catch such hidden consumption activities. The other side reflects also the already mentioned study issue: only limited amount of studies have been dealing with the consumption/demand side of the shadow economy (so far), which makes it than harder to prosecute.

On these grounds this paper deals with the demand side of the phenomenon of the shadow economy in Slovenia. It is based on the specially designed survey on the shadow economy in Slovenia (briefly presented in the previous section). The demand side is monitored via participants (i.e. who is behind the demand of the shadow economy), how much is spent (with respect to officially earned money), and purchasing (i.e. what goods/services are demanded on the shadow economy market).

Participants

According to the survey data almost 60 percent of the population in Slovenia spends money in the shadow economy. Similar to the findings above (on the supply side) more male (than female) participants are found on the demand/consumer side of the shadow economy. Pearson's Chi-Square test has a value of 8,070 and P-value is 0,004 to confirm this in the bellow contingency table.

Table 2: Contingency table: gender and consumers in shadow economy

Consumers in shadow economy	**No**		**Yes**		
Gender	**n**	**%**	**n**	**%**	**Total**
Male	131	34,9	244	65,1	**375**
Female	168	45,4	202	54,6	**370**
Total	**299**	**40,1**	**446**	**59,9**	**745**

Source: Survey of shadow economy.

Table 3: Contingency table: age and consumers in shadow economy

Consumers in shadow economy	**No**		**Yes**		
Age	**n**	**%**	**n**	**%**	**Total**
Up to 25 years	48	32,4	100	67,6	**148**
26 to 35 years	29	27,9	75	72,1	**104**
36 to 45 years	49	42,2	67	57,8	**116**
46 to 55 years	74	48,1	80	51,9	**154**
56 to 65 years	46	50,0	46	50,5	**92**
Over 65 years	53	40,5	78	59,5	**131**
Total	**299**	**40,1**	**446**	**59,9**	**745**

Source: Survey of shadow economy.

With the age distribution of the consumers in the shadow economy (table 3) we can notice, that in higher share consumers have (from 15) up to 35 years of age, whereas with higher ages there are less differences between those that consume in the shadow economy and those who do not. Pearson's Chi-Square test confirms this (test value of 18,144 and P-value 0,003).

Even with the education it can be seen (table 4) that consumers in the shadow economy are to a certain degree different from those who do not make purchases in the shadow economy. Chi-Square test has a value of 12,736 and with P-value of 0,026 we can conclude that those with the highest education level (relatively) buy more in the shadow economy, on the other hand, those with elementary school buy in the shadow economy in less than half occasions. Nevertheless, it can be seen that those with high school buy the most in the shadow economy, followed by those with elementary school and university).

Table 4: Contingency table: education and consumers in shadow economy

Consumers in shadow economy	**No**		**Yes**		
Education	**n**	**%**	**n**	**%**	**Total**
Unfinished elementary school	17	38,6	27	61,4	**44**
Elementary school	87	51,2	83	48,8	**170**
High school	152	37,5	253	62,5	**405**
Vocational	17	39,5	26	60,5	**43**
University	25	33,8	49	66,2	**74**
Masters, PhD	2	20,0	8	80,0	**10**
Total	**300**	**40,2**	**446**	**59,8**	**746**

Source: Survey of shadow economy.

Table 5 reveals the fact that pupils/students and employed persons spent (relatively) the most in the shadow economy (Pearsons's Chi-Square is 27,413 with a negligible P-value). Also, the pensioners are in higher share prone to consume in the shadow economy.

Table 5: Contingency table: status and consumers in shadow economy

Consumers in shadow economy	**No**		**Yes**		
Status	**n**	**%**	**n**	**%**	**Total**
Pupil, student	39	31,5	85	68,5	**124**
Employed	116	34,5	220	65,5	**336**
Unemployed, registered at the Employment Service	25	67,6	12	34,2	**37**
Unemployed, not registered at the Employment Service	15	57,7	11	42,3	**26**
Pensioner	101	47,0	114	53,0	**215**
Total	**296**	**40,1**	**442**	**59,9**	**738**

Source: Survey of shadow economy.

How much is spent

As has already been mentioned in section 3, only 17 percent of the money earned in the shadow economy is returned to the shadow economy via consumption there. This indicates that should the shadow economy be autonomous it would not last long. Thus, there has to be some injection of the funds/spending from other economy, from the official economy. We have already seen that nearly 60 percent of people in Slovenia spend money in the shadow economy. This means that 40 percent of people do not make purchases in the shadow economy at all. The survey reveals that above 45 percent of people use money from the official economy (earned there) to make purchases in the shadow economy, whereas more than 14 percent of them do not (they purchase in the shadow economy by the money earned there).

The table bellow reveals an interesting fact that those that work in the shadow economy also spend more in the shadow economy (74 out of 96, whereas those, who do not work in the shadow economy yet still spend money there are 365 out of 642).

Table 6: Contingency table: Working in the shadow economy and I use money from the official economy to make purchases in the shadow economy

	Working in the shadow economy		
I use money from the official economy to make purchases in the shadow economy	**Yes**	**No**	**Total**
Yes	52	280	**332**
No	22	85	**107**
I don't purchase in the shadow economy	22	277	**299**
Total	**96**	**642**	**738**

Source: Survey of shadow economy.

Out of those that stated they use the money earned in the official economy to finance purchases in the shadow economy (total of 332) over 37 percent answered they do not know how much they spend. Otherwise the percentages are revealed in the following table. A weighted average of consumption of official income in the shadow economy is 11,5 percent of all official incomes. Which amounts, in line of the calculations from section three, to 4,1 percent of GDP. Adding 17 percent of the earnings from the shadow economy which are spent in the shadow economy and transforming them to GDP percentage (17 percent out of 15,6 percent of shadow economy in GDP) of 2,7 percent, the total consumption in the shadow economy amounts to around 6,8 percent of GDP. We can add the savings (which amounts to 20 percent of the shadow economy earnings or 3,1 percent of GDP). This means that above 5 percent of GDP is missing from the data in the survey (the difference between what people

earn and spend in the shadow economy on a national level) and that this can be acquired from the consumption not by households but by companies (the part of demand in the shadow economy that was not studied by this survey).

Table 7: Percentage of official incomes intended for consumption in the shadow economy

How much (%) of your official incomes do you spend for purchases in the shadow economy?	**N**	**%**
0,0	2	0,6
0,1	2	0,6
0,5	3	0,9
1,0	15	4,5
1,5	0	0,0
2,0	11	3,3
3,0	9	2,7
4,0	3	0,9
5,0	38	11,5
9,6	1	0,3
10,0	71	21,4
12,5	0	0,0
15,0	16	4,8
20,0	23	6,9
25,0	1	0,3
30,0	4	1,2
35,0	1	0,3
50,0	5	1,5
60,0	0	0,0
70,0	0	0,0
100,0	3	0,9
I don't know	124	37,4
Total	**332**	**100,0**

Source: Survey of shadow economy.

What is purchased

Another important view of the demand side of the shadow economy is without doubt the goods/services that are purchased in the shadow economy. In the survey of the shadow economy this has been done by groups of products according to the COICOP/HICP classification (Classification of individual consumption on purpose, adjusted for the needs of harmonized index). The results (averages of consumption for n=397) are presented in the table bellow with the structure of the consumption in the population (Slovenia) in the last column.

It is evident that goods/services of food and non-alcoholic beverages (17 percent), clothing and footwear (12 percent), furnishings, household equipment and routine household maintenance (12), transport (including the repair of motor vehicles, 13 percent), and Miscellaneous goods and services (where one can find also financial and personal services, 15 percent) are the most important purchasing groups of products in the shadow economy. Comparing the consumption in the shadow economy it can be seen that in the shadow economy less housing, water, electricity, gas and other fuels, communication, recreation and culture, education, and restaurants and hotels goods/services are purchased.

Table 8: Consumption in the shadow economy by goods/services in %

Goods and/or services	**Sample**	**Population**
Food and non-alcoholic beverages	17,2	16,6
Alcoholic beverages, tobacco and narcotics	5,0	2,4
Clothing and footwear	12,0	8,0
Housing, water, electricity, gas and other fuels	7,1	12,1
Furnishings, household equipment and routine household maintenance	11,9	7,3
Health	5,2	1,7
Transport	13,4	19,2
Communication	1,5	5,0
Recreation and culture	6,5	10,9
Education	3,1	1,0
Restaurants and hotels	1,9	4,7
Miscellaneous goods and services	15,3	11,0
Total	**100,0**	**100,0**

Source: Survey of shadow economy, GDP, Yearly Data (2007).

POLICIES TO TACKLE THE SHADOW ECONOMY

In intuitive path regarding the size of the shadow economy is of course to minimize the shadow economy, as it escapes authority registration for taxing or regulation issues. The policies to fight the shadow economy can range from very restrictive ones, where harsh rules and their strict enforcement make it extremely hard for one to take actions in the shadow economy. The other extreme situation is the *laissez faire* policy, where no prosecution whatsoever is being enforced. In the former case the result would be pushing such activities way into illegal (even criminal) activities, hiding more and more from the restrictive authorities. In the latter anarchy might be the end solution. From this point of view none of the proposed choices is the proper solution to tackle the shadow economy. Rather, it lies somewhere in between.

This has also been established in various studies (European Commission (2004; 2007), Feige and Ott (1999), Frey and Schneider (2000), Kyle (2001), Schneider and Enste (2002), Dell'Anno and Piirisild (2004), Ott (2004)). One of the more recent by Nastav and Bojnec (2008) propose that entrepreneurial, tax, and other policies aimed at improving entrepreneurial incentives and decreasing the barriers to entrepreneurship reduce the size of the shadow economy. This line of thought is the main guideline for the fighting-the-shadow-economy policy implementation, focused on the production/supply side.

Based on the established findings in the previous section we can see that in general participants in the shadow economy on the demand side do not differ much from the participants on the supply side. Besides, the majority of those working in the shadow economy also purchase goods from the shadow economy. The consumption, however, differs slightly from the production in the shadow economy, yet this point could not be completely resolved from the survey data because the two sides were measured according to different classifications. And the lack of data (units and the lowest level on the classification) proved themselves as the main obstacles to do so. Nevertheless we can assume more or less adjusted supply and demand side in the shadow economy. Furthermore, the reasons why people turn to the demand in the shadow economy comprise lower prices and flexibility of the supply (European Commission, 2007).

Combining these it can be seen that the policy is better to be focused on the production side – as mentioned in the sense of improving entrepreneurial environment and governments' efforts to channel entrepreneurial activities from the shadow economy into the official one. This conclusion can be made on the survey on shadow economy conducted in Slovenia, yet with other, more in-depth analysis this can alter. Also, one needs to bear in mind that only the household consumption in the shadow economy was studies with the survey.

CONCLUDING REMARKS

In the paper we tried to provide answers to three main questions. The first one deals with the definition of the shadow economy, where we propose a schematic approach to show the interaction of shadow economy and other connected areas, which are sometimes regarded as synonyms, but without proper ground to do so. We can conclude that tax evasion, illegal (black) economy, informal sector or household production for own final use cannot be used as synonyms for the shadow economy, since they only overlap. On the other hand, underground economy (as defined by OCED, 2002) and undeclared work (as defined by European Commission, 2004; 2007) have the same definition as the shadow economy: productive activities whose products are legal but the production itself is deliberately concealed from authorities.

Second, we have seen that the demand side is an autonomous side of the shadow economy,

yet to a greater extent in line with the production side with respect to participants and a somewhat lower degree with respect to the goods/services purchased in the shadow economy. However, the survey studied only the household side of the demand, thus the supply and demand sides were not in line with respect to the money earned/spent in the shadow economy on the national level. We have come across the fact that 15,6 percent of GDP was earned in the shadow economy, yet only 7 percent of GDP were destined for consumption and additional 3 for savings. For proper picture on the total demand side in the shadow economy the firms have to be studied as well.

Regardless of this discrepancy we propose the policy aiming at tackling the shadow economy is better to be focused on the production side in the sense of improving entrepreneurial environment and governments' efforts to channel entrepreneurial activities from the shadow economy into the official one. This is because the participants, carriers of work and consumption, vary only slightly on both sides (supply and demand) of the shadow economy and by gradually decreasing incentives for either side, both, the supply and demand sides of the shadow economy will reduce.

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APPENDIX

Table 9: Comparison of the sample and weighted sample against the population with respect to different variables.

Variable	Sample	Population	Weighted sample	**Variable**	Sample	Population	Weighted sample
Gender				**Status**			
Male	42,6	48,6	50,5	Pupil, student	17,6	13,7	15,4
Female	57,4	51,4	49,5	Employed	52,2	50,0	42,2
SSD	72,0		7,22	Unemployed, registered at the Employment Service	3,9	4,0	4,4
				Unemployed, not registered at the Employment Service	2,9	0,8	4,1
Age				Pensioner	23,5	31,6	33,9
Up to 25 years	21,6	16,5	18,9	SSD	90,1		80,1
26 to 35 years	21,2	17,5	12,8				
36 to 45 years	17,5	17,7	14,2	**Region**			
46 to 55 years	13,9	17,9	19,1	Pomurska	5,9	6,1	7,6
56 to 65 years	11,9	13,1	13	Savinjska	11,4	12,8	12,9
Over 65 years	13,9	17,3	21,9	JV Slovenija	7,9	6,9	7
SSD	69,3		62,0	Notranjsko-kraška	4,4	2,6	3,1
				Podravska	13,1	16,1	14,6
Education				Zasavska	3,8	2,3	1,9
Unfinished elementary school	0,8	4,6	5,7	Osrednjeslovenska	25,8	24,9	22,5
Elementary school	10,1	23,0	24	Goriška	5,8	6	7,1
High school	50,4	55,7	54,1	Koroška	2,6	3,6	5,6
Vocational	13,2	5,5	5,7	Spodnjesavska	1,5	3,5	3,4
University	21,6	9,9	9,4	Gorenjska	11,4	9,8	9,1
Masters, PhD	3,9	1,2	1,2	Obalno-kraška	6,3	5,4	5,4
SSD	414,0		5,0	SSD	26,71		16,4

Note: SSD – sum of squared deviations of the sample from the population

Source: own calculations.

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Dynamic Reorder Points for Manufacturing Execution System: a Case Study for Testing Equipment in Hard Disk Drive Factory

Varintorn Boonsiri and Pornthep Anussornnitisarn
International Graduate Program in Industrial Engineering, Kasetsart University
fengpdp@ku.ac.th

ABSTRACT

The nature of electronics industry demand is drastically fluctuating. Slow in response to demand can lead to the loss of customer to competitor. The number of new products is higher every year to cover all segment of the market. The goal is to serve all customer demand with the lowest possible cost. Manufacturing execution system with an integration of Inventory management system has played important role to optimize the response time and the product cost. This article demonstrated the management aspects of inventory of machine parts in a hard disk drive manufacturing company. Those machine parts are assembled on the testing machine. The demand of required components are calculated based on master production schedule (MPS) of the enterprise resource planning system (ERP) which is released once a week. The machine parts are ordered to the maximum requirement per each quarter. At present, the method of inventory tracking is carried out manually, based on experience, without using any theoretical approach. In 2007, the case company forced to reschedule and decline customer demand for 2000 production lots caused by machine parts shortage. The primary objective of this study is to determine the optimal level of inventory, which is related to the ordering plan. The developing of an inventory model is incorporating into company's manufacturing execution system. The manufacturing execution system involves determining the optimal stock and ordering policies for the critical component. However, the study is important also on the implementation of the new inventory monitoring system in the warehouse, on intranet to enhance the inventory control system in practice. The benefits of this system also help company to better handle the growing number of items and their attributes.

RESEARCH BACKGROUND AND MOTIVES

The nature of electronics industry demand is drastically fluctuating. Products have to be launched and delivered as quickly as possible while the number of new products and its components has been grown to cover many industries e.g. communication, control equipment and entertainment etc. Slow in response to demand can lead to the loss of customer to competitor. The number of new products is higher every year to cover all segment of the market. The goal is to serve all customer demand with the lowest possible cost. Manufacturing execution system with an integration of Inventory management system has played important role to optimize the response time and the product cost; as Silver et at. (1998) suggested, a company's fate depends on how it manages its inventory. This article demonstrated the management aspects of inventory of machine parts in a hard disk drive manufacturing company. Those machine parts are assembled on the testing machine. The demand of required components are calculated based on master production schedule(MPS) of the enterprise resource planning system (ERP) which is released once a week. The machine parts are ordered to the maximum requirement per each

quarter. The spending cost for purchasing the machine component is contributed 30-40% of overall equipment spending each year. An inventory of equipment components of the manufacturer has several special features in comparison with the inventory of raw materials and consumable materials. 1) Demand of Equipment components depends on the usage of machine and the number of primary product production, 2) The need for equipment components can be planned only to a limited extent, 3) equipment component demands has capacity planning.

The quantity of equipment component inventories were derived manually, which was error prone and less efficient, resulting in inventory overstock/out of stock. At present, the method of inventory tracking is carried out manually, based on experience, without using any formal approach. In 2007, the company lost the opportunity for producing 35,000 units caused by machine parts shortage.

The primary objective of this research is to determine the appropriate inventory level of equipment components, which are related to the MPS. By developing inventory analytical model into current manufacturing execution system such as optimal re-order points and ordering polices for the critical component. In addition, the new inventory monitoring was developed for all staffs related to a particular component such as purchasing, industrial engineer, manufacturing engineer, maintenance staffs and inventory personals, to be able to trace and track the inventory level of the critical components of his/her responsibility. This inventory monitoring system is very useful since the number of products and its components continue to grow. This research is to improve the process of equipment ordering plan, confirm the setup ability to support the master schedule built plan. Those can be monitored online instead of using manual tracking.

Table 1: Current Practice in controlling equipment's components

	Current Situation	
Unit	Component part of the testing machine	
Item	300 and more	
Quantity	64,000 and more	
Withdraw Schedule	Per machine setup plan from each master production schedule	
Withdraw by	Machine setup team	
Control by	Industrial Engineer Team	
	Current Practice	**New Manufacturing Execution System**
Store System	Paperwork with manual tracking	Computer application
Inventory Status	Manually check upon requirement	Online and real-time report
Scrap System	Upon requirement when over space limit	Obsolete product
Plan to Order	Focus on ramping product and compare with the machine requirement plan	Inventory model
When to Order	Current stock is not enough to support the machine requirement plan	Inventory model

Quantity to Order | Maximum requirement in each quarter | Inventory model

LITERATURE REVIEW

The normally practice of the company is using **Inventory Speculation Strategy**. The inventory speculation approach is, by far, the most frequently encountered inventory management approach in practice (Zinn and Bowersox, 1988; Pagh and Cooper, 1998). The firm would purchase items and physically hold such items within its storage facilities before demand or usage requirements for the items are known with certainty (Bucklin, 1965). The responsive time to demand would be quick. However, there is also the incurrence of high inventory cost and holding cost.

However, without a stable production environment, manufacturing resources trend to be devoted to reacting to constant schedule changes instead of achieving process improvements. Chapman (1990) recommend using statistics on demand and manufacturing lead-time to determine the approximate size of the downstream inventories necessary to stabilize manufacturing schedules. This isolates manufacturing from demand fluctuation when inventory is used as the barrier.

Inventory stock depends essentially of two factors:

1. Demand: the amount of items that will be consumed. This study demand is based on sale forecasting that is converted to machine capacity requirement with uncertainty.
2. Lead-time: the delay between reorder decision and renewed availability. The condition of constant lead-time for equipment ordering is applied to this case.

Basically only two decisions need to be made in managing independent demand inventory: *how much to order (size)* and *when to order (timing)*. The answer to the question about how much to order can also be based on two criteria. The ordered quantity is either a pre-determined order quantity Q or a variable quantity, which supplements the inventory in each case up to a certain order level S. This study is order based on desired inventory level (S) upon receipt of replenishment order and the order is placed whenever the stock level reaches a reorder point (R) (Vollmann, Berry and Whybark, 1997)

Table 2: Inventory Decision Rules

Order Frequency	***Order Quantity***	
	Fixed (Q)	Variable (S)
Variable (R)	Q, R	S, R
Fixed (T)	Q, T	S, T

Q = Order at fixed quantity
S = Order up to a fixed expected opening inventory quantity (S)
R = Place an order when the inventory balance drops to (R)
T = Place an order every (T) period

The reorder point is the amount of stock that should trigger an order. The reorder point would simply be equal to the total forecasted demand during the lead-time, also called lead-time demand.

Reorder point = lead time demand + safety stock

The lead-time demand can be computed as the sum of the forecasted values for the future.

The safety stock is the amount of inventory additional to reorder pint for cover uncertain demand ruing the lead-time for avoid stock out. The disadvantage of having a lot of safety stock is the tied up holding cost and cost of items in inventory. Deciding the level of safety stock is implicitly equivalent to making a trade-off between those costs considering the uncertainties. That can be considered as service level. The service level expresses the probability that a certain level of safety stock will not lead to stock-out.

For probabilistic demand $D \sim N(\mu, \sigma)$, in which demand during the lead time is $D_L \sim N(\mu_L, \sigma_L)$ with

μ = mean (average) demand
L = lead-time
μ_L = expected demand during the lead time = $\mu * L$
σ_L = standard deviation of demand during the lead-time = $\sigma * \sqrt{L}$
□ = Prob(no stock out during the lead-time)
S = safety stock = NORMINV (□)* σ_L
Reorder point = ($\mu * L$) + NORMINV (□)σ_L

The research focuses on the determination of appropriate inventory level in each period. The concept of reorder point is applied to the inventory model.

SYSTEM DEVELOPMENT

System Analysis

The current practice for ordering the machine components is to order based on the maximum number of the requirement in each quarter. The inventory is reviewed occasionally base on the experience to notice of each industrial engineer. In the past, demand in each master schedule had slightly difference. Recently, demand in each master built plan can be dramatically fluctuation. To prevent the shortage of machine capacity, the components have to be prepared properly. Inventory model and tracking system enhance the efficient ordering plan. Those roles can be used as decision-supporting tools for minimize the machine parts shortage with the optimal inventory cost. Ordering policy of the firm is currently using Periodic Review, which requires reviewing the inventory level at fixed points in time. In this case the reviewing is per each master schedule built plan, once a week.

There are fives critical components to apply for inventory model. The critical parts are the components, which the requirement, based on one-year projection plan, is more than the current inventory on hand. The inventory model is not necessary for the parts, which have higher inventory on hand than the requirement. The requirement of those parts is specific to the product

configuration in the road map. One component type is commonly use for support 3-7 products at a time. Cumulative demand of one component can be shown a large growing number. Based on the statistical testing, the nature demand of each component can be represented as normality distribution.

Replenishment lead-time is 12 weeks, which included purchasing ordering (1 week), vendor fabrication lead-time and qualification (8 weeks), shipping lead-time (1 weeks) and setup lead-time (2 weeks).

Ordering Policy

The requirement of equipment component is reviewing periodically by weekly per each product requirement plan. There are many component parts for supporting machine setup. The focusing of an industrial engineer who reviews the inventory status comparing to the machine requirement is on the critical components. The critical components normally are parts for support the ramping product or high volume during that period of time.

The company practice for spending on machine components is controlled yearly. Then the maximum number of component to be ordered cannot over the maximum requirement of that part in one year. The new order is planned to receive when the inventory level is zero or receive new order when we expected the order to be used. The regulation of equipment ordering is not included safety stock unit. The benefit of this process is it easy to define the number of part to be ordered. The disadvantage is inventory level is fluctuated based time to order.

Decisions

The decisions to be made are to desire how much to order and when to order. Those calculated thorough the inventory model. The components to apply the inventory model are the parts that are commonly used among product. The summation of requirement from each product has to be transformed.

Decision factors are depended on customer demand, lead-time and nature of the supply line. Customer demand is based on master requirement planning (MRP) and convert to capacity requirement planning (CRP). The forecasting is planed for one year in basis.

Lead time is the amount of time from the point at the need to order is determined to the point at which the inventory is on hand and available for use. It include supplier or manufacturing lead time, time to initiate the purchase order or work order including approval steps, time to notify the supplier, the time to process through receiving and inspection operations, also with the setup time before release the machine to the production line.

The nature of the supply is considered as reliable supplier with unlimited capacity and constant delivery lead-time. Based on the historical information, defect parts are rarely found from the supplier as they qualified the components before ship. Then, there is no impact of component quality to be considered in the model.

Input and Output Data

To construct an inventory model for the component planning, there are many related input data that can be shown in Figure 1 together with the expected output of the inventory model.

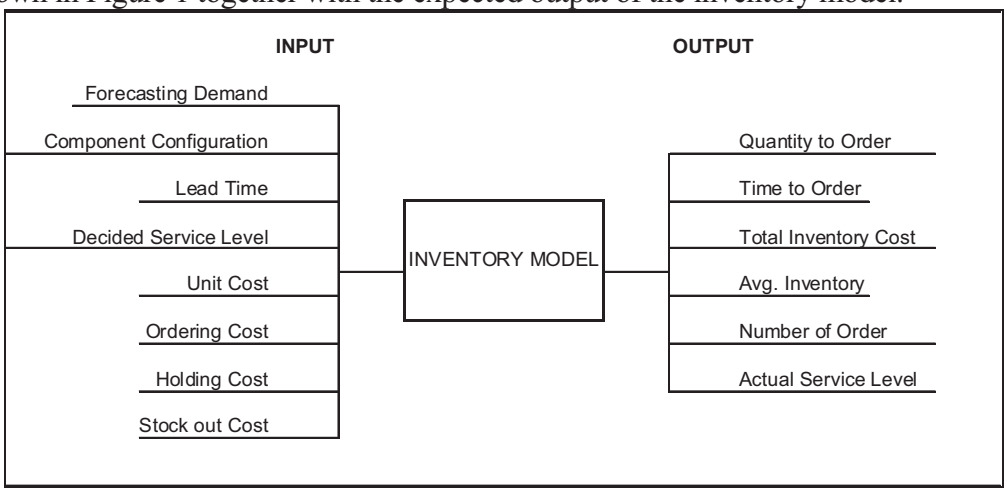


Figure 1: System input and output

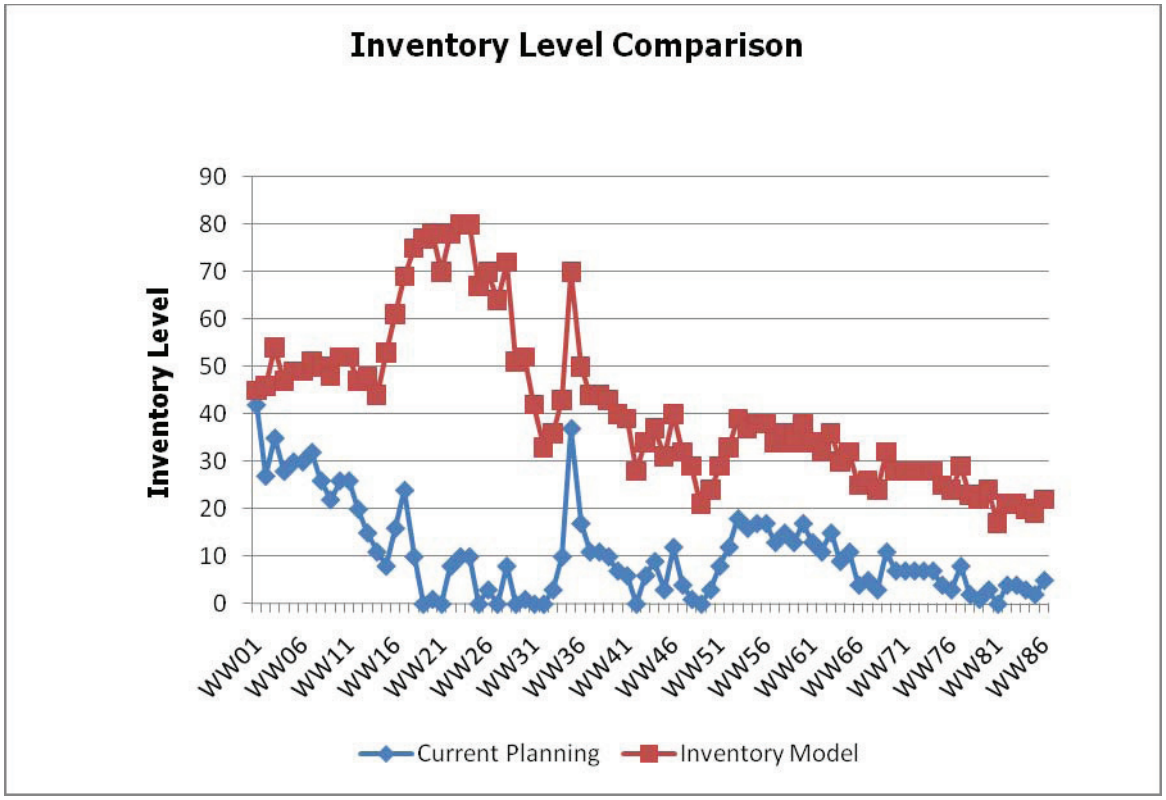
Results

Model Comparison and Analysis

This research focuses on service level that could be controlled for prevent part shortage. This session is examining the result from the inventory model to ensure that the inventory model enhances higher the service level with the lower cost. Since there are too many components, only a component called board#1 is used to illustrate to result of new manufacturing execution system.

Base on the same requirement of Board#1, totally there are 63 sets of Board#1 have to be ordered for support the demand of April'08 until June'09. The average service level is equal to 47%. The average service level can be tremendously improving after applying the inventory model to calculate the suitable stock level. With the new model, the average service level in one-year is increased to 98%, or 52% improvement. The model suggests to order the item more than the maximum requirement in one year. For Board#1, their are17 units over the maximum requirement for maintaining the service level above 90% for very period. Board#1 inventory level from two planning processes can be shown as in Figure 2. The inventory level is shift up when applying inventory model in planning process. That have the directly reflected to higher service level. By the way, the holding cost in this case increases due to higher inventory level as well. For trade of between service level and holding cost, the cost equation should be applied as a justification tool for planners. The 10 times of zero inventory form the current planning is eliminated.

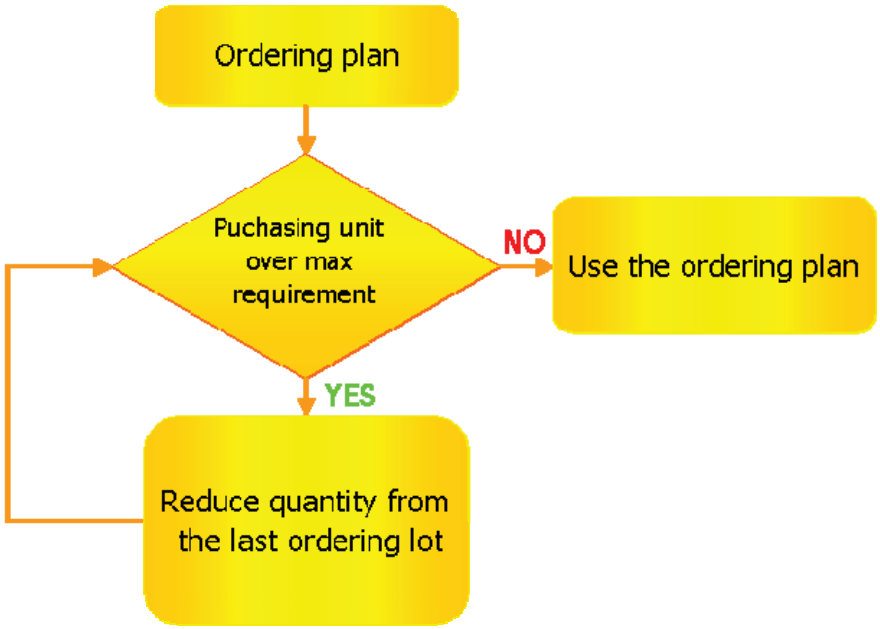
Figure 2: Board#1 Inventory Level Comparison of The Original Plan with The Inventory Model



Model Improvement

From previous section the inventory model have been proved that it can enhance higher service level with less cost. Anyways, there is some room to improve total cost of inventory model and maintain service level within the target. The quantity to order, which is suggested by the inventory model, is more than the maximum one-year requirement of those parts. That is against the current practice of not to order more than the maximum requirement. The company allows having zero inventories when the components reach the maximum requirement. The process of deduct the over demand is developed and the flow chart can be shown as in **Figure 3**

Figure 3 The Flowchart of an Improvement Model



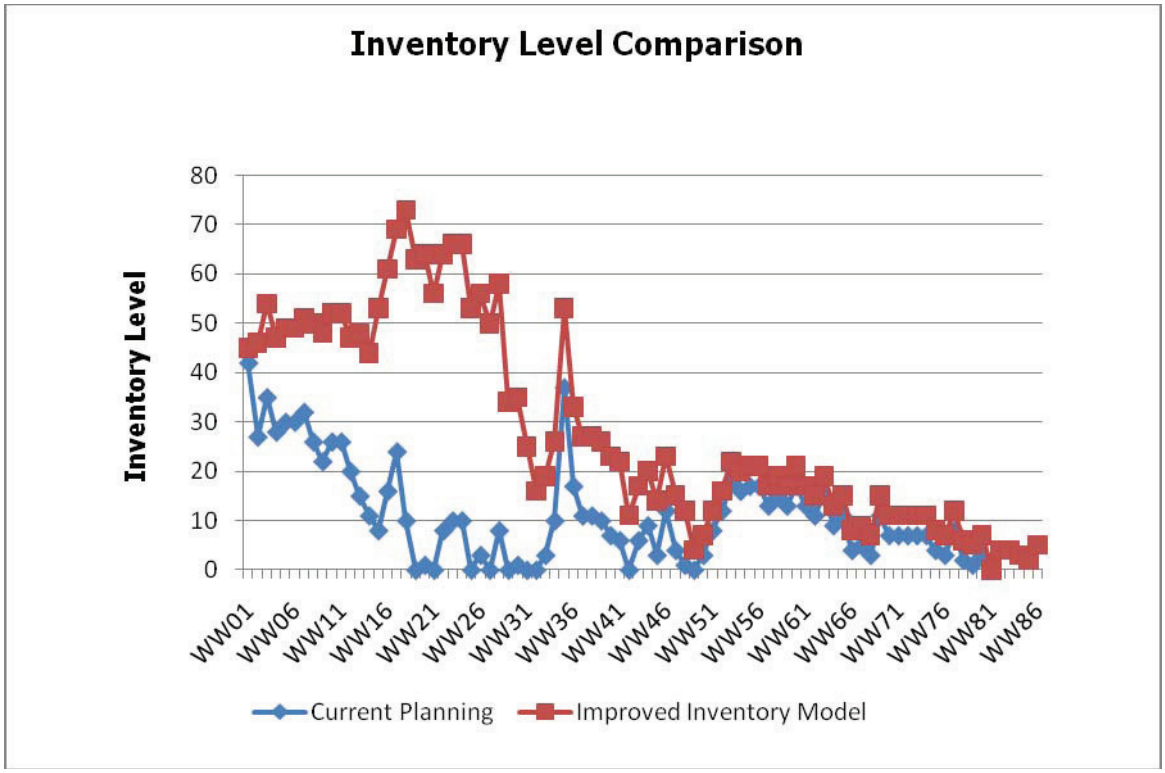
Board#1 requirement is still the base line for comparison. The target is to order the component not over the maximum requirement of each part. The exceeding unit over the maximum requirement will be deduced from the last lot to be ordered. In Board#1 case, there are 17 exceeding units from the maximum requirement.

After reducing the exceeding unit from the plan, the service level is reduced from 98% to 90% that still within the decided service level. The total cost is reduced from the lower number of average inventory and unit to be ordered. Total cost is $64,811 with the adjusted plan. While the total cost from inventory model without any adjusts is $71,982.

Total numbers to be ordered from those 2 planning are equal at 63 units or equal to the maximum number that is allow to ordered (not over the maximum requirement). The average inventory is increased from 11 to 28 units that are caused of the increased service level from 47% to 90%. The number of order is reduced from 9 to 8 times. Total cost has large reducing number from $106,950 to $64,811 per year, which is $42,140 reduction or about 39% cost reduction.

In the period, which has the maximum requirement, inventory supposed to be zero as following the practice of not order over the maximum capacity in one year. In this case, inventory is zero in that period has the maximum requirement at 276.

Figure 4: Board#1 Inventory Level Comparison of The Original Plan with The improved Inventory Model



The process of planning with following the inventory model with adjusts the number to order not over the maximum requirement will be used. The expected benefits are higher service level with lower cost. In practical, the inventory model with adjusted the number of unit to be ordered is using. The purpose is not to order the component over their requirement of one year.

CONCLUSION

The study starts with the analysis of the existing system of inventory management, determines the problems of the current practice, defines its functional requirement, design inventory model and design a computer-based system for such an application. The inventories models have been applied for calculate order quantity, safety stock quantity and stock level follow statistics

determination. The model is using as a decision-supporting tool for the users to define the proper quantity to order and when to order follows the design probability of stock out. The inventory model is linked with the master requirement plan then it can be updated per each weekly plan.

The new computer software has been developed to ensure that stock balances are accurate and will remain accurate. It comprehends inventory management model and inventory tracking system. This software includes features, designed to help users effectively manage warehouse stock. The real-time inventory report and on-line deposit/withdraw requisition enhance timely manner.

The inventory level is decreasing after implement the inventory tracking system. The target is to reduce the storage space by half or more. The current storage area of this equipment is 30 m^2. After implement the system for 3 months, the storage space was reduced to 25 m^2. And the responsive time for inventory status can be eliminated due to the inventory on hand can be reported real-time by accessing to the system. The operation time for users and setup team are reduced with significant difference after implementing the online system. The impacts of stock-out have to take more than 6 months (component part lead-time) to reflex the impact. Anyways, the service level can be confirmed at 90% confidential of not having a stock-out. **Table 3** shows the summary benefits of this project implementation. Also the processing times of operation before and after implement the store inventory system were observed. The processing time before having the system was about 14 minutes per cycle. After having the system the processing time is reduced to 8 minutes per cycle, which is significant different after testing by statistical method.

Table 3: Space saving

Measurement	Objective	Manual Process	Inventory Model&System	
			3 months after used	1 year target
Storage Space	Minimum	30 m^2	25 m^2	< 15 m^2
Inventory Checking	Minimum	2 hours	0	0

Table 4 Process Time Improvment

Item	In Charge	Description	Objective	Standard Time (sec)		Delta
				Before	After	
1	IE	Deposit part to Store IE	Minimum	0	85	85
2	IE	Prepare part for withdraw	Minimum	512	160	-352
3	Setup Team	Withdraw part from Store IE	Minimum	343	243	-100
		TOTAL		855	488	-367

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THE RELATIONSHIP BETWEEN CRITICAL SUCCESSFUL FACTORS (CSFS) AND PERFORMANCE OF ERP SYSTEMS IMPLEMENTATION – VIEW OF IMPLEMENTATION PHASES

Wen-Hsien Tsai*, Shu-Ping Chen, Yu-Shan Shen
Department of Business Administration, National Central University, Jhongli, Taiwan
whtsai@mgt.ncu.edu.tw

ABSTRACT

The main objective of adopting an Enterprise Resource Planning (ERP) system is to conduct the business processes of an organization more effectively and efficiently with the integrated and real-time information. Successfully implementing an ERP system helps enterprises with increasing their competitiveness, promoting their ability to respond quickly, enabling the employees to have easy access and fast retrieval of information or reports, enhancing the accuracy of information for strategic planning and operational control, as well as achieving other benefits. Moreover, ERP systems are the integrated, expensive, risky and modular information systems. It will be a disaster for a company to encounter an ERP implementation failure. Many enterprises have experienced lots of problems during the ERP systems implementation. Therefore, the Critical Success Factors (CSFs) of ERP implementation is a very important research field. A lot of studies have classified the CSFs of ERP implementation by different categories. However, there have been few studies to explore the relationship between CSFs and performance of ERP implementation.

The main purpose of this study is to examine the relationship between CSFs and effective performance of ERP implementation. Data collected from questionnaires will be analyzed by using Regression Analysis. Besides, this study also considers the concept of implementation phases of ERP systems. From the research results, companies will understand the relationships between CSFs and effectiveness performance of ERP systems implementation in each implementation phase.

Keyword: Enterprise Resource Planning (ERP), Critical Success Factors (CSFs), ERP Implementation Phases

Subject Area: e-Commerce and e-Business

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A CASE STUDY ON EMERGENCY STRATEGY

Scott, S.C. Lung*, National Kaohsiung First University of Science & Technology, Kaohsiung Taiwan
sclung@ccms
Chung Lin Ho, National Kaohsiung First University of Science & Technology, Kaohsiung Taiwan
nkfust.edu.tw

ABSTRACT

Business survive and prosper are the sustainable goals that manager want to achieve, a company's ability to survive and prosper depends critically on choosing and implementing a good strategy. A strategy formation must be initiated and identified the change of external and internal in the boundary of company, does it is enough for manager to make decision and allocation resource by formal strategic planning? It is the motivation that we are interested and studied in this topic. Realized strategies are from the planned strategy and emergency strategy, only partial of planned strategy could be realized. And the issue that related to the planned strategy has been studied completely and the emergency strategy is the main issue in this research.

Opportunity emerges in the interface of environment and organization and complexity in chaos. Therefore, we should know how to identify the emergency event, the factors of chance from the phenomenon study of emergency strategy should be cultivated, and how the phase of manage view will be changed during emergency strategy is implementing; the three questions are that we want to understand. In this studying, the identical process for emergency emerging, elements of phenomenon for emergency strategy in three dimensions – Effect, Event and Environment and three phase changes-Recognize, Developing and Change of management views for emergency strategy success are the significant outcome of the research and theoretical Implemented by one empirical case, the contribution of this study is that extend the knowledge or thinking from conventional strategic planning for managers to facing unexpected change form environment in real business operating.

Key words: Emergency Strategy, Chaos, Unexpected Change.

INTRODUCTION

A strategy is a set of related actions that managers take to increase their firm's performance. If a firm's strategies result in superior performance, it is said to have a competitive advantage. Hence, the several studies of strategy often focus on the strategy-making process, strategy formation and strategy implementation that related to superior performance, competitive advantage (Hill and Joses 2007).

A lot of studies related to strategy is focus on the planning procedure, but is planned strategy inadequate for business? How company to do for facing the opportunity from unexpected change? The questions are this research that wants to get the solutions. Why do some companies succeed while others fail? Therefore, the strategic manager needs to know the central questions as what's happening in our industry. What's our competition going to next? How should we respond? What can we do to make money in our business? The answer a firm develops for these questions is a firm's strategy. And most agree that a company's ability to survive and prosper depends critically on choosing and implementing a good strategy (Barney and Hesterly 2006).

Even though there are many complete and deliberate studies for subject of strategy, implicated that a firm's strategies are the result of strategic planning process and it is a rational and highly structured activities. Adversely, do all strategies make by rational planning? How to process the strategy making at unpredicted event happen due to the change by chaos? How to manage when the serendipitous discoveries occur? What's the effect in organization at this impact (Hill and Joses 2007)? That is the initiate and motivation to make this research.

The strategies of most organizations are probably a combination of the planned and the emergent. The message for management is that it needs to recognize the process of emergence and to intervene when appropriate, killing off bad emergent strategies but nurturing potentially good one (Hill and Jose 2007). Therefore, how a message could be triggered out to be a successful emergency strategy? How to fertilize and intense when the emergency strategy emerges? The issues are the main objectives of this research.

The process of planned strategy were completed and developed in many studies. Actually, it is also difficult to be a realized strategy due to unpredictable change and chaos in ambiance if you deliberate progressively the process. The opportunity is emerging in tiny implication not from original thought and occurrence when implement the planned strategy. Therefore, we try to develop a process to identify the emerging for emergency strategy.

The initial message is the most important of emergency strategy formation, and then the emergency strategy could be bred or terminated in internal and external environment. What's the phenomenon of emergency strategy? What are the elements of emergency strategy formation? We erect a model to interpret this question is the second objective of this research. The breakthrough result of emergency strategy success is accomplished by the dramatic change in organization. What's the procedure of this change? How to manage such

emergency strategy in broadly viewpoint after formation model is the third objective of this research.

LITERATURE REVIEW

We want to know and get profile of the real formation of strategy in dynamic environment, the present planning for approaching to unexpected change. The literature review is divided four parts includes the real approach of strategic planning process, realized strategy, chaos and review planning approach.

Real Approach of Strategic Planning Process

Many researchers have emphasized that strategy is the outcome of a formal strategic planning process and the top management plays the most important role in the process (Andrews 1971), there are fives steps for a typical formal strategic planning process:

(1) Select the corporate mission and major corporate goals.
(2) Analyze the organization' external competitive environment to identify opportunity and threats.
(3) Analyze the organization' internal operating environment to identify the organization's strengths and weaknesses.
(4) Select strategies that build on organization's strengths and correct its weaknesses in order to take advantage of external opportunities and counter external threats. These strategies should be consistent with the mission and major goals of the organization. They should be congruent and constitute a viable model.
(5) Implement the strategies.

The task of analysis the organization's external and internal environment and then selecting appropriate strategies constitutes strategy formation. The strategy implementation involves putting the strategies into action, the important thing that manager need to do is aligning project management with business strategy.

However, in spite of having such rational and highly structured strategic process that is orchestrated by top management how to react to dynamic environment and unpredicted world. But it is unpractical way to make a strategy and to be action plans, should have an alternative view of strategy really making and know the strategy as revolution (Hamel 1996).

Realized Strategy

Only realized strategy could be benefit to company and it is the driving force every company

need. The sources of realized strategy are the issue we are interested.

The realized strategy from Mingtzberg's Model is the product that the firm wants to put into action. There are two resources that one source formintend (planned) strategy and another is emergency strategy, the change is a key factor that influences the planned strategy to be unrealized. (Mintzberg and McHugh 1985)

Emergency strategies that are unpredicted responses to unforeseen circumstances could be another source for realized strategy.They arise from autonomous action by lower-level managers, unplanned shifted by top-level managers and serendipity event. The formal planning model is criticized for non-practical is always unpredicted; the lower-level managers can not involve more in the strategic management process, and the fact that many successful strategies are often the result of serendipity, not rational. (Burgelman 1991)

(1) Serendipity: it is the effect by which one accidentally discovers something fortunate, especially while looking for something else entirely. There are many examples of accidental event that erupt a dramatic power to benefit the company, and the successful strategies are not the outcome from well-planned process. On the other hand, some companies ignored the serendipity discoveries and events, and then missed out the profitable opportunity. The main reason is that the conception of such emergency strategyy formation is not consistent with formal strategy process.

(2) Autonomous action: a research presents an intra-organizational ecological perspective on strategy making, and examines how internal selection may combine with external selection to explain organizational change and survival. And proposes that consistently successful organizations are characterized by top managements who spend efforts on building the induced and autonomous strategic processes, as well as concerning themselves with the content of strategy; that such organizations simultaneously exercise induced and autonomous processes; and that successful reorientations in organizations are likely to have been preceded by internal experimentation and selection processes effected through the autonomous process (Burgelman 1991). Obviously, the emergency strategy emerges from low-level management are influenced more too realized strategy make.

(3) Unplanned shift by top-manager: not all the decisions made by top-manager are correct, sometime changing environment will alter renewal strategy to be available and benefit. It is necessary to do the project portfolio management and review the renewal project for emergency strategy developing.

Chaos is Normal Status

Some opinions related to this issue that suggested by Mintzberg are then presented in terms of three central themes: that strategy formation can fruitfully be viewed as the interplay between a dynamic environment and bureaucratic momentum, with leadership mediating between the two forces; that strategy formation over time appears to follow some important patterns in organizations, notably life cycles and distinct change-continuity cycles within these; and that the study of the interplay between intended and realized strategies may lead us to the heart of this complex organizational process. (Mintzberg 1978)

Scientists are developing revolutionary new ways of understanding how nature functions. They have recently discovered that systems in nature (for example, a gas) are capable of endless variety because their dynamics are chaotic - unpredictable new patterns emerge through a process of spontaneous self-organization (for example, a laser beam). Since human organizations are dynamic feedback systems just as nature's systems are, these new discoveries - chaos and self-organization - apply to organizations and provide managers with a fundamentally different way of understanding their strategic development. Managers need to plan or envision the long-term future of an innovative organization. Instead, they must create and discover an unfolding future, using their ability to learn together in groups and to interact politically in a spontaneous, self-organizing manner. (Stacey 1993)

Stacey's eight principles (Stacey 1993) for creating a complexity based change process was built after a case study of change intervention, that assist managers wanting to know how to undertake complexity inspired change. Manager should maintain the organization climate under these eight principles to facing change.

(1) Create a strategic involvement process
(2) Use participative and egalitarian workshops
(3) Provide overt commitment from the top
(4) Create temporary self-organizing project teams
(5) Work with enthusiasts
(6) Provide a supportive learning environment
(7) Key people should understand complexity
(8) Consider the transition model of strategy

Review Planning Approach

The traditional planning are frequently based on the assumption that tomorrow's environment will be much like today. The forecasts on which many plans are based provide unrealistic assumptions about the organization's future environment. Environmental changes are so rapid and complex that accurate predictions are difficult.

In today's world, effective planning must incorporate unpredictability. Two planning approaches which are designed to help prepare for dramatic or rapid changes in the environment, are scenario planning and contingency planning. (Bloom and Menefee 1994)

(1) Scenario planning: simply defined, a scenario is a description of a possible or probable future. The scenario defines a set of future events or circumstances that would affect the organization's performance (Bloom and Menefee 1994). A scenario is a description of a possible or probable future. Scenarios convey projections of the future with various possibilities rather than one single set of conditions or one single view of how the future might look. Planning with scenarios allows an organization to examine several options or risks that might have been overlooked in a plan that was constructed around a single environment. The process forces managers to think about the unthinkable and to even plan for it.

(2) Contingency planning: like scenario planning, anticipates future events and incorporates alternative plans. Whereas scenarios usually look at a wide range of possibilities within an organization's environment, contingency plans focus on a particular event over a relatively short time frame, one that demands a rapid response and quick action. Contingency planning involves the advance preparation of a course of action to meet a situation that may not be expected but that, if it occurs, will have a significant impact (positive or negative) on the organization. Because crises and emergencies often arise, contingency planning helps to prevent the shock of complete surprise.

Unpredicted change is a real Phenomenon in our business environment and almost could not give any assumption or background to predict emergency occurrence, what's element that could describe well about emergency strategy emerging? Does the process of planning are enough to manage the formation of emergency strategy emerging? These are the interesting things that we are studied by this research.

RESEARCH MODELS

This research was settled up to explore and illustrate in how emergency strategy is emerged and what the potential energy manager can cultivate in his organization, manage it to archive success. Given the availability of funding and time available, the research was designed to be exploratory. That is, it was recognized that only a limited number of cases study and survey data could be undertaken, there is much room for additional research in this area.

Case study method

The case study method is particularly appropriate for exploratory research since cases are descriptive and explanatory. This research is considered to give a descriptive profile through the studies of Honda (50cc Motorbike), Pfizer (Viagra) and 3M (Masking tape) from literatures review to realize the identical process, elements of phenomenon and process to success of emergency strategy for getting the whole picture of this issue of emergency strategy, although the three cases study were selected from literature review but important well-know model.

Semi-structured interviews for empirical case were conducted with senior managers of company A (A successful emergency strategy of a new drug development in a conventional chemical engineer company) by using a questionnaire-based approach. Data and information gathered from the interviews, and documentation from company A, were analyzed and synthesized to develop models of how emergency strategy was formulated and implemented. The results and findings of each case study were validated by company A before a cross analysis of all the results and findings was carried out.

The prominent and breakthrough performance for emergency strategy is the key point we are interested and really worth studying and what are the elements of phenomenon for emergency strategy are the other issue we desire to know.

Elements of Phenomenon for Emergency Strategy in Three Dimensions

Strategies grow intimately like weeds in a garden; they are not cultivated like tomatoes in a hothouse (Mintzberg and McHugh 1985). The emergency strategy is like as weed in the garden, what's the factor fertilized the weed? What's the cause for them budding? How much energy they can erupt? Those are questions we want to study and try to interpret such phenomenon of emergency strategy in three dimensions of Environment, Event and Effect.

(1) Environment

It is usual to separate the environment of company into internal and external for restricting and analyzing in a scope, but we must realize that the normal status of internal and external is the non-linear dynamic and complex, complex adaptive systems are self-organizing, learn and adapt, and develop emergency strategies to perform at the 'edge of chaos' (McMillan and Carlisle 2007). The self-organization and chaos are two elements for phenomenon for emergency strategy in aspect of environment.
Change and complexity thinking are two things that every organization should be copied with.

Kotter argues that management is about coping with complexity, and leadership, in contrast, is about coping with change (Kotter 1990), absolutely, the leadership of organization completely could not be excluded this element as study of this dimension.

(2) Event

The identical process describes clearly from the emergency event to be terminated or a breakthrough and success strategy, but we still need to know the elements behind the event.

A source of emergency strategies is the autonomous action by lower-level managers as behavior of self-organization, therefore, learning, innovation in business culture are key elements for formation of emergency strategy. Another element is the feedback loop and the quick response of emergency strategy is depended by this channel erect. Motivation is strongly intervening such event occur that related to the leadership of organization, the happened opportunity of event is increase in vigorous self-organization than inactive.

The serendipity is the characteristic of emergent event and will be triggered by a minor or ambiguous signal, sometime identify by sense or intuition of manager. Even though it is very hard to manage it happen, manage after serendipity happen is necessary, and the “Process Model for Identify Emergency Emerging” is an available flow for you doing the work.

(3) Effect

Why so many researchers are interested in Emergency Strategy? The breakthrough and enormous effect is one main reason of all. The timing and decision make are two elements for processing effect measure and allocating resource.

As a normal strategic planning, the impact access, evaluation and allocation of resource are three sequential procedures to implement the strategic plan, the magnitude of effect for emergency strategy is influenced prominently by the intervening factors of timing that related to such procedures with contrast to formal strategy.

Moving Emergency to Prominent Strategy: Study from 3 Success Cases

This research is considered to give a descriptive profile through the studies of Honda (50cc Motorbike), Pfizer (Viagra) and 3M (Masking tape) from literatures review to realize the identical process, elements of phenomenon and process to success of emergency strategy, and get the whole picture of this issue. It is impossible to return the original condition of three

cases only from literature, so combining with the other literatures and trying to give an overall of this issue.

In the beginning, developing a process to identify the emergent emerging, the terminating or deliberately strategic planning are two main decisions. What are the factors that could be influenced in making decision, the potential capacity that organization should be cultivated for catching the opportunity? Analyze in environment, event and effect dimensions. Final, suggest a process of 3 stages to approaching the emergency strategy success. Three cases were analyzed in aspects of background (refer to Table 1), unexpected change that try to figure out the profile of success.

Table 1 Emergency Strategy Outcome for three cases

Environment	Emergency Event	Effect
Case 1: Honda – Motorbike (Supercub)		
Chaos in market 1. Market penetration: USA motorbike. 2. Original market target: 250-350cc.	Signal-trigger: surprise ride 1. Japan executive used the Honda 50s to run errands around los angles. 2. A call from Sear, demand for selling 50cc bike.	Impact/performance 1. Found that untied channel of distributor: general retailer, not specialty motorbike 2. By 1964, nearly one out of every two motorcycles sold in USA was a Honda.
Case 2: Pfizer (Viagra)		
Self-Organization It was initially studied for use in hypertension (high blood pressure) and angina pectoris (a form of ischaemic cardiovascular disease)	Signal-Trigger Incredible Side Effect 1. Phase I clinical trials under the direction of Ian Osterloh suggested that the drug had little effect on angina. 2. It could induce marked penile erections. Pfizer therefore decided to market it for erectile dysfunction, rather than for angina.	Impact/Performance 1. The drug was patented in 1996, approved for use in erectile dysfunction by the FDA in 1998. 2. It soon became a great success: annual sales of Viagra in the period 1999–2001 exceeded $1 billion.
Case 3: 3M (Masking tape)		
Planned Strategy McKnight charged drew with developing a stronger adhesive to better bind the grit to the paper backing.	Serendipity Signal Trigger: Customer Need 1. While experimenting with adhesives, Drew developed a weak adhesive that not as planned. 2. Drew observed his weak adhesive could be used for auto-body workers as painting.	Leadership Allocation of Resource McKnight charged Drew together helped build 3M and shaped its organization culture.

Source: Hill and Joses 2007, Kling, 1998

An Identical Process for Emergency Emerging

The sources of emergency strategy arise from autonomous action by lower-level managers, unplanned shifted by top-level managers and serendipity event. There are signals triggerred from accidental event of business operating (Bloom and Menefee 1994), the reaction of ignore or neglect is common result after intuitional identified, and then termiante if no prominent effect.

On the other hand, miss any signal with possibly and forwardly prominent effect that could be a pity thing and manger must avoid such thing happen. Xerox PARC (Palo Alto Research Center, Inc.) was the case that is best known for inventing laser printing, Ethernet and so on, but did not transfer to benefit company maximally.

It should be intensified the process after identify the ambiguous event to be desired product. In fact, the extremely low possibility of such events would be turned a feasible strategy, a lot of events as weeds in garden (Mintzberg and McHugh 1985) or ripple on the lake will be terminated due to little effect or unrealistic. In spite of the extremely low possibility still could not misestimate and neglect the power when the emergency event happen, their breakthrough effect often change the company dramatically in the future.

We can image the consequence of three cases if manager of Honda reject the call from Sear for implementing their original planning, manager of Pfizer only concentrate the develop of hypertension and McKnight of 3M still focus on the strong adhesive, nothing could be achieved if these events that were considered as absurd at that time were terminated.

Even though the emergency event was identified desired, still needs to be done through formal strategic management process to become action plan, it is necessary to magnify the effect of this event. Sometime the plan from emergency do not become a realized strategy due to the resistance of organization, the inertial of organization and the scanty of innovation will also terminate the emergency event.

Phase Change of Management for Emergency Strategy Success

Formation and implement are two stages in strategy-making process for formal strategy management (Andrews 1971); there are many components in each stage that need to be done deliberately. All processes are breakdown from vision, mission, goal, and then progress step by step. It is absolutely necessary to align the processes to the original goal, and pay attention to realize between goal and dynamic environment.
In fact, it is not adequate for only doing strategic planning in conventional way As SWOT,

the unpredictable still existed in environment. Scenario and contingency planning are two processes for strategic planning to face the unpredictable and unthinkable, this is also the important issue to emergency strategy, the process for identify emergency emerging and elements of phenomenon for emergency strategy in three dimensions are provided to reinforce such strategic planning.

All processes of strategic planning could be utilized for emergency strategy if fitted on environment and timing, but the phase changes of emergency strategy from initiate to success were obviously discovered and existed in studying.

Phase1: Recognize

The status of phase 1 are the chaos and opportunity, the process that need to done is identify and evaluation.

(1) Chaos: it is the source for emergency strategy, incident and event occurs in boundary of organization need to be screened.

(2) Opportunity: opportunity is often triggered by an alert or signal, could be identified by process for identify emergency emerging and elements of phenomenon for emergency strategy in three dimensions.

Phase2: Developed

Strategic planning and allocation of resource is the works in this phase and the planned need to be implemented.

(1) Strategic planning: strategic planning for emergency strategy is based on timing.

(2) Allocations of resource: risk identifies and makes decisions are key factors that related to this phase.

Phase3: Change

Organization could be shaped to new form after success and the management of change is the key issue to this phase. A new business model could be built up in this phase. After understanding of the three phases, manager should boost up these activities and control chemical reaction in organization to enlarge the performance in life cycle of emergency strategy.

THEORETICAL IMPLEMENTATION-EMPIRICAL CASE

A successful emergency strategy of a new drug development in a conventional chemical engineer company (Abbreviated "Company A") is the case that selected to do empirical research. Company A is a branch company from a large traditional conglomerate in Taiwan, cement, power supply and chemical materials are main products. Diversification is the consistent strategy of the group and company A is carbon black maker that supply to tire industry, therefore company A is selected to implement this developing of new business and pharmaceutical is the potential option.

The case of emergency strategy looks like a lucky investment due to abundant business network, but this serendipity triggered by a kind mind, and then deliberately strategic management is really worth studying. At first, focus on the case of orphan drug and survey the top mangers in company A by a questionnaire related to dimension/element of phenomenon for emergency strategy.

And then interview with present general manager to realize the whole profile of orphan drug, compile with contrast to process of identify emergency emerging, dimension/element of phenomenon for emergency strategy and three phases of management for emergency strategy success to make a summary comment.

Background of Company A

Company A core business is the manufacture of Carbon Black (CB). Until now, there are seven production sites around the world: one in Taiwan, three in the US, two in Mainland China and one in India. Total capacity of CB stands at 640,000 MT a year, making company A to be the 4th largest supplier of CB worldwide. Company A's technical expertise in CB production has been acknowledged worldwide for decades.

Further exploit CB technology by licensing the know-how to Continental Carbon Australia (CCA) and Alexandria Carbon Black Co., Egypt (ACBC). It is a globalize business group.

Since its establishment in 1973, company A has successfully faced a series of challenges, overcome difficulties, taken important steps towards diversification and internationalization, now is one of the four largest carbon black manufacturers in the world.

After 1990, due to diversification of group policy company A endeavored in developing of bio - technology and pharmaceutical industry, had production bases in Taiwan, North America and Europe, and has actively developed new markets in Southeast Asia, South Asia, Mainland China and Central and South America. In Taiwan, company A has engaged in joint

ventures with other members of group in the petrochemicals, electronics sectors, while also playing a leading role in the development of the pharmaceutical industry. From a kind mind and unplanned strategy and turn to NT$ 14~27 billion incomes for patent licensed, the emergency strategy of orphan drug changed completely in the pharmaceutical business developing of company A.

From international to diversification, company A has two clear visions:
(1) China number one in carbon black industry.
(2) Make use of new business model in R&D of pharmaceutical industry.

The New business model of R&D is that developed from emergency strategy of orphan drug and that is why we interested in doing this research.

Orphan Drug Initiates from Kindly Mind

The general manager of company A handles the project of orphan drug, and has applied a new patent in Japan and European. The interview time is around 30 minutes, place is in the office of company A‘s headquarter. We sum the interview result in table as Table 2.

Table 2 Interview Summary of Company a related to Orphan Drug

Question	Summary
What’s the background of Pompe research?	The opportunity of drug developing for Pompe was like as a seed of weed in the business garden of Koo Group.
Describe the emergency event for Pompe case.	The emergency event is from human sympathy and signal-trigger is kindly mind, not go through a deliberately strategic planning.
What’s the impact to company?	Developed a new business model for joint adventure of R&D in pharmaceutical industry.
Breakthrough performance	A 17 years license of patent approved by FDA, EMEA and the income of loyalty is around NT$ 14~27 billion.

Survey Result by Questionnaire: Case of Orphan Drug

Erect three dimensions “Environment, Event and Effete” in order to describe the emergency strategy, there are several elements in dimension that related to such phenomenon. The elements that related 3E model are the main items of questionnaire and hope they answer by their opinion of the case of orphan drug in company A, will make a brief introduction for

participants about the 3E model before his questionnaire fill in.

The elements of 3E model that related to emergency are rating by interval scale from 0% to 100%. Before participants finished the questionnaire, will interview and explain briefly for realize the elements of 3E model. The questionnaire was finished, and then collected immediately after interview. There are four top managers of Company A to interview, includes General Manager, Market Director, Technical Director, Technical Manager.

The score of all elements are over 75% and only the evaluation element in dimension "effect" is 50% agree. The feedback result of participants that related disagrees of evaluation is as Table 3. The element should be included, but not attribute directly to be main factor in success of emergency strategy, the constantly monitor and status control are suitable response after emergency event occur, it is should be done after identified opportunity and before allocation of resource.

Table 3 Survey Result for 3E Models

Dimension		Agree Percentage
Environment		
Internal:	Self-Organization	100%
	Leadership	100%
External:	Chaos	75%
	Unexpected Change	75%
Event		
Autonomous Action:	Learning	100%
	Innovative	100%
	Feedback Loop	75%
Serendipity		75%
Effect		
	Access Impact	75%
	Evaluation	50%
	Allocation of Resource	75%

*100%: 4 Participants agree. *50%: 2 Participants agree, 2 none.

DISCUSSION AND CONCLUSIONS

The strategy formulation of organization has always filled the thrilling process. Most of organizations which using the multi-utilization massive materials, by the forecast scientific rapprochement, or the situation simulation analysis, thought that will plan suits the organization future the most suitable development program. In the change management of famous saying "the change will be only invariable", it will let the strategy plan be always unable to obtain the optimization the implementation. An organization often takes a nonchalant news, actually lets the organization have obtains a rebirth opportunity. Otherwise

it neglects the signal which knocks on a door, but causes the organization to fall into under the mud. There are many changes in a life of person or an organization that make him success, but only few could catch these opportunities to accomplish. What is the reason for such more changes losing? The usual reasons are that too late to be ware of, no capacity of yourself to catch.

The organization carries in the decision-making process, hopes that can catch the weak sound which God knocks on a door. Indeed these weak sounds are often first line personnel's hearing. It must penetrate the huge communicate system through organization, but becomes an important development strategy, as if needs a luck. This research takes Honda (Motorbike), Pfizer (Viagra), and 3M (Masking tape) as examples. We propose the 3E model for strategy formulation, explained that appears emergency strategy in the plan process the importance.

Indeed this also contains the influence of risk management, specially mentions the Type I or II Errors in statistics. If the policy-maker is not a risk-lover, he/she often overemphasizes the disaster which Type II Errors bring to hesitate. How much of the successful probability of an innovative product launch into a new market? Only hears the God weak sound luckily, and earns the following organization's support, the emergency strategy can obtain the execution success. The strategies of most organizations are probably a combination of the planned and the emergent. The message for management is that it needs to recognize the process of emergence and to intervene when appropriate, killing off bad emergent strategies but nurturing potentially good one (Hill and Jose 2007).

Therefore, how a message could be triggered out to be a successful emergency strategy? How to fertilize and intense when the emergency strategy emerges? The Orphan Drug is the successful cases for emergency strategy in Company A, these manager that make emergency strategy to success are not just lucky people, but also are excellent executor from their the unique vision and pragmatic management style. Hereafter, this precious experience tells the higher management of Company A, the news or noise which maybe influences the strategy development must be necessary to carry monitoring or explanation. So long as but has a news or noise success, it should rather obtain the benefit than spend suitable time and cost. It is a big difficult issue, that how should establish the news or noise supervisory system, or to explain the effects of trivial matters floating in the clouds. If an organization can obtain these news or noise inspirations, it will be a “paradigm shift” for the future development. The key findings from the research are as below, wish it is helpful to increase your management knowledge and raises up your management skill.

Key Findings and Discussion

It is necessary for formal strategic planning that is an ordinary activity in company, but still existing many unexpected and unknown changes during implementing the plan from formal strategy. Opportunity emerges in the interface of environment and organization, knowing the process of identifying and identify from the phenomenon for emergency strategy are prioritized first. The identical process just an initiate point to success of emergency strategy, the phases of management will be changed during emergency strategy is implementing.

The identical process for emergency emerging, elements of phenomenon for emergency strategy in three dimensions. These three phases of management for emergency strategy success are the main contributions of this research. Its objective is that extending the knowledge or thinking from conventional strategic planning for managers to facing unexpected change form environment.

Meanwhile, building up the efficient and flexible self-organization is the soft power to undertake changes. Stacey's eight principles (Stacey 1993) for creating a complexity based change process was built that assist managers wanting to know how to undertake complexity inspired change.

Even though the final performance from a success of emergency strategy is enormous and breakthrough, the risk should be controlled deliberately and simultaneously due to the essential characteristic that contributes by unexpected change from chaotic environment.

Limitations and Future Directions

Three cases that are studied and adapted by literature review are not completely approaching to the real history due to inadequate information, and it is very hard to return back to the original condition. These cases that are analyzed by background, unexpected change - emergency event, effect and result are not enough to give the whole profile to such emergency strategy. Therefore, the validity of identical process for emergency emerging and elements of phenomenon for emergency strategy in three dimensions is influenced by inadequate information.

The questionnaire to managers of company A for theoretical Implementation is only settled by one case of orphan drug; the limitation is that the case is strongly related to network relation of group chairman not from autonomous action from low-level manager.

In order to verify precisely the relationship of variables of identical process, elements of phenomenon and three phases of management for emergency strategy success, future

directions are that researches should be done more in such case study of emergency strategy that origin from autonomous action.

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REVIEW OF BUSINESS GROWTH STUDIES – FOCUS INDUSTIES AND PROCESSES

Mr. Matti Muhos, University of Oulu, Finland
matti.muhos@oulu.fi
Prof. Pekka Kess, University of Oulu, Finland
pekka.kess@oulu.fi
Mr. Sitthinath Sanpanich, Kasetsart University, Bangkok, Thailand
Dr. Kongkiti Phusavat, Kasetsart University, Bangkok, Thailand
fengkkp@ku.ac.th

ABSTRACT

This study identifies the focus industries and processes among the company growth configuration studies published during the past 60 years. Many growth configuration, stages of growth, and company life-cycle models have been formed to clarify the managerial challenges and priorities in the early growth of private, profit seeking companies. The models vary widely in numbers of stages and transitions, growth indicators used, size focus, industry focus, and process focus – this leads often to confusion. There is no extensive review about the common patterns, trends or the potential new research topics inside this perspective; this study seeks to clarify the focus industries and processes. First, the 90 configuration studies selected for this analysis are presented and further divided into three groups of analysis. Second, the industry and the process focus among the studies are analyzed to detect the commonalities and trends. Third, implications for the future research are presented. The intention of this study is to address the well covered areas and to indentify the promising new viewpoints for the scholars interested in studying company growth configurations. In this study, a meta-analytical methodology is used.

Keywords: configuration models, company growth, growth process, small and medium sized enterprises, new venture creation

INTRODUCTION

The growth of company can be divided into growth stages and transitions. Many scholars have formed models to clarify the managerial challenges and priorities in the early growth of companies during the past 60 years. The stages of growth perspective (See 13; 14; 27), company life-cycle perspective (See 14; 27) or configuration perspective (See 39) are commonly utilized to label this group of studies. In this study the term configuration perspective is used. Three other commonly mentioned perspectives are the resource-based perspective, the motivation perspective, and the strategic adaptation perspective (See 39; 9). These focus on the factors leading to growth while configuration studies (39) are concerned how the growing organization should be managed. Configuration perspective is profoundly different from other perspectives focusing on how the problems appear and can be managed in typical stages of development (9). The main concern is what growth brings to an organization (39). The firm growth is considered as the starting point – the consequences of growth is the main concern of this perspective. According to Miller et al. (24 p. 1) "Organizational structures, production systems, information processing procedures, strategies and environments all tend to influence each other. Our thesis is that they do so in such a manner that gives rise to a small number of extremely common configurations…

Configurations may represent common organization structures, common scenarios of strategy making in context, and even common developmental or transitional sequences."

The need for configuration studies is based on a multidimensional nature of growth. The growth indicators such as number of employees, sales and assets show if the company is growing or not. However, when the company is growing, there are multiple dimensions that management needs to focus. The growth configurations literature reveals that there are different key managerial problems specific for the different growth stages. The configuration perspective seeks to describe what growth brings to a company, and further how a growing company could be effectively and efficiently managed. The configuration perspective is not applicable to the group of companies that are not growing or do not want to grow.

A wealth of company growth, development and creation models is derived from the configuration perspective, but the models have a variant number of attributes that limit the implementation of the models to any context. The models vary widely; variance can be found in type, level of empirical evidence, focus business, growth dimension, number of stages etc. (See i.e. 35). The aim of this study is to identify the focus industries and processes among the company growth configuration studies published during the past 60 years. This study is addressed to the scholars interested on the process perspective on company growth and development. The study detects well covered areas, highlights trends, and provides some ideas for the future studies.

The research questions of this study can be articulated as follows:

1. What are the focus processes and industries among the company growth configuration studies of the past 60 years?
2. What implications for future research can be derived from the analysis?

This is a meta-analytical study (See i.e. 15) focusing on the configuration models of company growth and development. While primary analysis focuses on the original data to answer to research question, secondary analysis focuses on the analysis of the same data in order to answer a new research question or better answer the original research question. Meta-analysis focuses on analysis of a collection of research results in order to integrate some of the findings. The meta-analysis, the analysis of analyses, is needed when the literature of a certain type contains tens or even hundreds of studies are dealing with the same area on interest (See i.e. 15). This is the case with the studies on configuration viewpoint. First in this study the configuration studies related to growth of private profit seeking companies are identified and grouped into three periods of analysis. Second, the focus industries and processes are studied in order to identify commonalities and trends. Third, some implications for the future research are presented.

This study was carried out as a collaborative effort between the University of Oulu and the Kasetsart University. The basic sample of configuration studies was collected during in the three first quarters of the year 2008 in Oulu, and the qualitative and quantitative analysis of the sample was carried out during the third and fourth quarters in Kasetsart University as part of the Duo-Thailand Fellowship Program. The writing of the results took place during the winter 2008-2009. This paper consists of four chapters.

THE SELECTION OF THE STUDIES AND THE THREE GROUPS OF ANALYSIS

At the beginning of the analysis the preliminary sample consisted of 120 configuration studies from 1940s until today. The studies were mainly collected during the first three quarters of year 2008. However, some groups of configuration models are out of the scope of this study (See Figure 1). These models include models focusing on processes on a macro level such as nations (See i.e. 5; 30; 32), mass movements (See i.e. 18), industry (See i.e. 25; 28), cluster (See i.e. 3), or a network (See i.e. 6; 19). The other group of models, related to company development, is the models focusing on a micro levels such as models related to a development of an individual in the organization (See i.e. 34) and the product development/life-cycle models (See i.e. 1; 10; 12; 16; 22; 31). The private profit seeking company is at the focus of this study, the unit of analysis. The excluded categories are related schools of thought, but focusing on a different level of analysis. On the horizontal level, there are relative configuration models as well. On the other hand, there are models related to public organizations (See i.e. 8; 11; 21) and non-profit organizations (See. 4), and on the other hand there are voluntary organizations (See i.e. 20; 29; 36). These models are related, but also excluded from the focus of this study. At the focus of this study are configuration models related to private, profit-seeking companies. However, many models considered as general models contributing over horizontal categories (private/public, profit/non-profit, voluntary/non-voluntary etc.) are included into this study because they also seek to contribute to the focus group – private, profit-seeking companies. Finally the sample of studies was selected based on a private company focus.

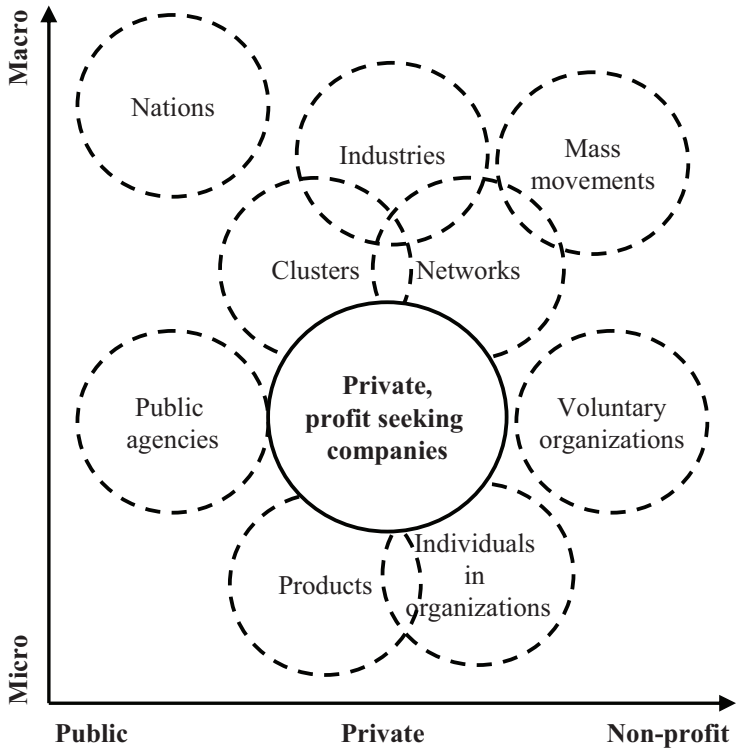

Fig 1. Defining the unit of analysis

The primary audiences and the types of publication are the following. Among the sample of studies 69% are journal articles, 27% are books or book contributions, and remaining are

others, such as conference proceedings, research reports and unpublished studies available. The primary audiences of the studies vary from purely academic to purely pragmatic. Majority, 68% of the studies, is primarily addressed to the academic audience in a sense that these can be defined as purely academic or academic. Of the studies 10% are addressed primarily to the pragmatic audience or are considered as purely pragmatic. Of the studies 20% consider both academic and pragmatic audiences equally. The sample of models studied and three groups of analysis are presented in Figure 2.

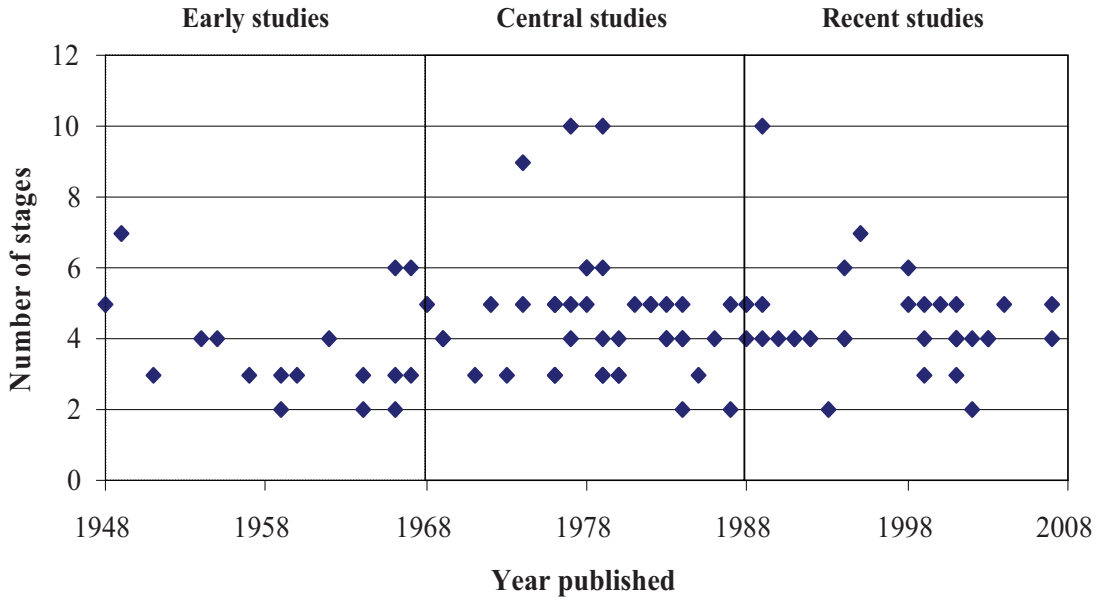

Fig 2. The three groups of models analyzed

The meta-analysis of the attributes is provided in this study both through the entire sample and through three groups of analysis. The analysis of the total sample provides an overview of studies and the separate analyses of three groups seek to detect the commonalities and trends. The groups are presented in Appendix 2. The trends in the configuration perspective were studied in three 20-year time periods starting from 1948. The first group, the early studies, consists of the modes published between years 1948 and 1968. The second group, central studies, consists of the models published between years 1969 and 1988. The third group, recent studies, consists of the models published between years 1989 and 2008. The grouping was made for a comparison of these three time periods to clarify the general trends in the configuration school of thought. In chapter 3 the analysis of the general trends among these three groups of models is presented. In the first group was found 18 studies, in the second group was found 41 studies, and in the third one 31 studies. The 90 reviewed configuration models and three groups of analysis are presented in more detailed manner in appendix 1.

THE FOCUS BUSINESS AND THE FOCUS PROCESSES

The analysis of the focus businesses and the focus processes among the configuration studies was made based on the total sample of 90 configuration studies and the three groups of analysis; the early, central and recent studies.

Focus industries – the commonalities and trends

The analysis of the focus industries was made following the Standard Industrial Classification 2002 (SIC). The focus businesses of each study were interpreted based on the definitions in the SIC. Some of the studies are not addressed to a specific industry - that is why a "general" or universal (GE) category needed to be added. However, the industries defined in SIC are agriculture, hunting and forestry (A), fishing (B), mining and quarrying (C), manufacturing (D), electricity, gas and water supply (E), construction (F), wholesale and retail trade (G), hotels and restaurants (H), transport, storage and communication (I), Financial intermediation (J), real estate, renting and business activities (K), public administration and defence (L), education (M), health and social work (N), other community, social and personal service activities (O), private households employing domestic staff and undifferentiated production activities of households for own use (P), extra-territorial organizations and bodies (Q), and industry unknown (X).

Of the total 90 models 66% have a general industry focus (GE), but may mention one or more specific industries. Of the studies clearly defining one or more focus business 44% are focused on manufacturing. One or more other industries are at the focus only in less than 10% of the studies analyzed. The other industries that are at the focus of 7 or more studies are G, I, and J. The remnant, the industries at the focus of four or less studies, are K, M, N, A, C, H, O, and F. Industries B, E, L, P, Q, and X are not found at the focus among the studies analysed.

The proportion of the studies focusing in manufacturing sector is similar through the three groups of analysis (early 44%, central 39%, recent 52%), though rising in the third one (See fig 3). In the first two groups (1948-1968, 1969-1988) the proportion of general studies is similar (early 72%, central 80%). However, the amount of general studies is dramatically reduced in the recent studies (1989-2008) where the proportion of general studies is only 41%. In the similar vein, the proportion of the studies focusing on the industry-specific studies is raised. In the early and central studies, around the same proportion is concentrated on industry-specific studies. Among the recent studies the proportion of industry-specific studies is dramatically bigger (doubled in many cases). In the first group of analysis, the industry specific studies deal with industries D, G, C, H, I, J, and O. In the second group, the focus of industry-specific studies is on D, G, M, J, I, and N. In the third group, the focus is on industries D, I, G, J, K, N, A, H, C, F, M, and O. The industries that are mentioned in all three groups of analysis are D, G, I, and J, which are also the most common focus industries among industry specific studies throughout the entire period of analysis. There is some variance between the focus industries presented in early and central studies. Some of the industries covered by early studies are absent in central studies (C, H, and O) and some industries covered by central studies are absent in early studies (M and N). However, the recent studies include all the earlier (early, central) presented focus industries and moreover add new ones such as A, F and K.

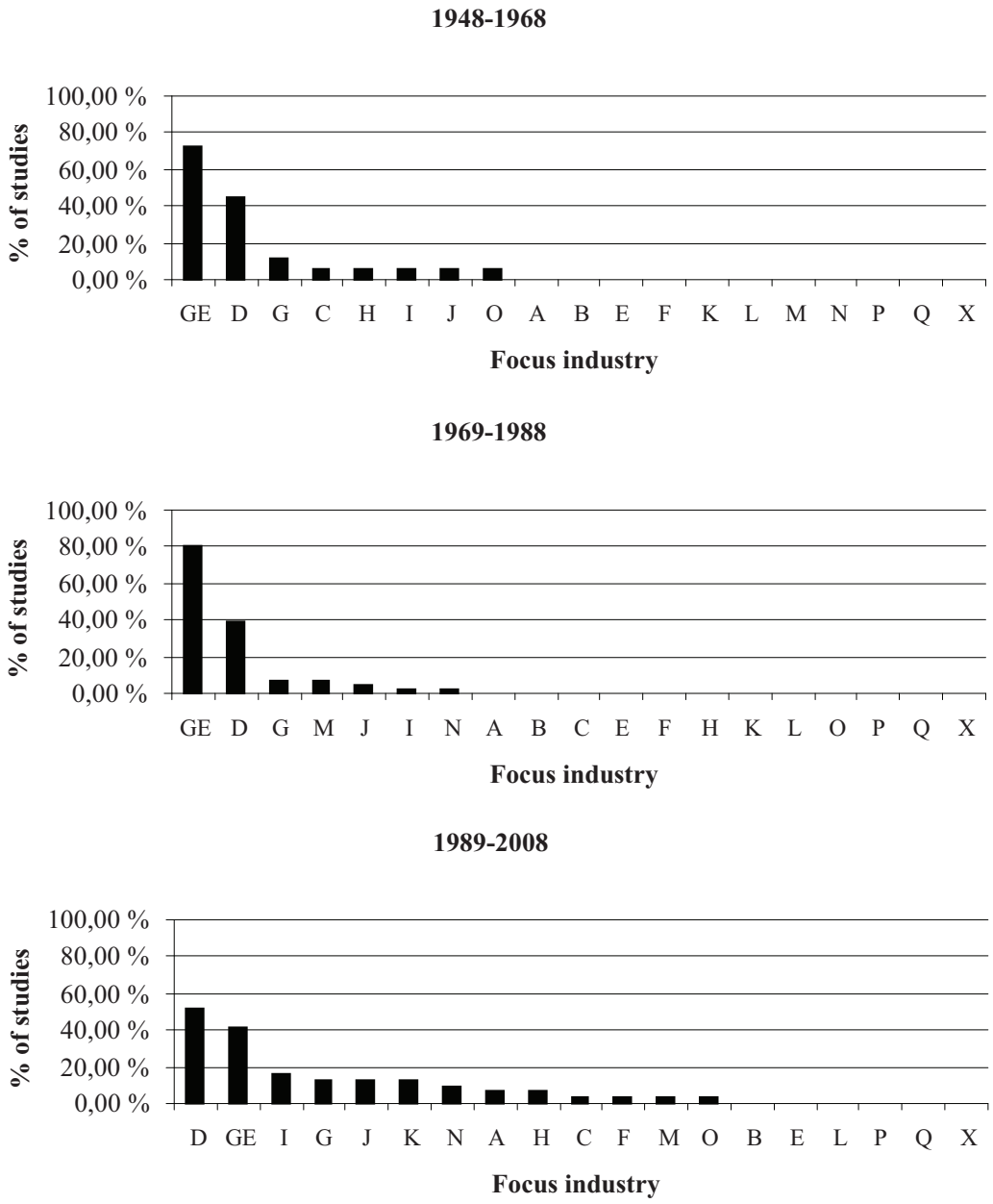

Fig 3. Focus industries - the commonalities and trends

Two main conclusions can be drawn. First, the main shift is from general studies to industry context specific studies, and second, the industry base among the recent studies is remarkably wider than in two earlier ones. These two dramatic shifts are taken between the central and the recent studies. What then has lead to these shifts? The universal models of company growth have faced some criticism. One question concerns about the applicability of the models across different industries. The industry is unique – some of the configurations are unique inside a certain industry leads to a need for industry-specific configuration studies. The natural shift was taken in the late eighties and early nineties to address the need. On the other hand the industries continue to diversify and new challenges arise in terms of the applicability of the earlier studies to the most recent industrial contexts. The current trend

seems to lead both towards more in-depth studies focusing the industries earlier addressed and studies focusing on new industrial contexts. Naturally, this may reduce the proportion of the general approaches.

Implications from the analysis of focus industries

Several industry contexts have been mentioned frequently among the studies. First of all, universal and manufacturing focused studies were mentioned in this category. Especially among the early and central studies, many authors tend to look at the growth process without distinction between different industrial contexts. The studies focusing on growth process of the manufacturing businesses represented significant portion already among early and central studies. Manufacturing has been and still is the most common specific industry category among the studies. The portion of universal (GE) growth configuration studies dropped dramatically in the group of recent studies from up to 80% to 41%. At the same time the percentage of studies focusing on manufacturing rise from up to 44% to 55% and many other industrial contexts were brought in. The proportion of context specific studies was dramatically increased among the recent studies. The manufacturing focused studies have provided a wealth of both conceptually and empirically based studies. This group of studies has already reached mature stage including several empirically based taxonomies. However, the configuration viewpoint is different among the subcategories of the manufacturing industry, which is a huge field providing wide range of new perspectives. More in-depth analysis is needed. When the other relatively common industry focus areas such as G, I and J are considered, the number of studies is significantly smaller. Among these studies both studies including empirical evidence as taxonomies can be found, but in profoundly smaller numbers. There is still an urgent need for more empirically based studies in these industrial contexts.

This analysis revealed some industry contexts that the configuration perspective could found interesting new context-specific challenges. These contexts include industries that have been mentioned in configuration studies from one to four times and the ones that have not been mentioned at all among the studies analyzed. When the first group is analyzed, most of the industries have only been considered from contextual viewpoint or with a weak empirical context. Further, most of these contexts have been opened from configuration viewpoint only in the most recent literature. These industry contexts open very interesting empirical research challenges. Both empirical studies to test the existing relatively rare typologies as the empirically based taxonomies could add value to these contexts. When the second group is analyzed, there can be found industries very often managed by public authorities, but more recently opened for the private organizations. These are E, L, and Q. However, more and more private organizations can be found functioning in these industries – these may open very interesting research topics for the scholars representing configuration perspective to the private profit seeking organizations in that field. As mentioned, the public perspective to these fields has been considered in some studies excluded from this research, but the private perspective is new. Configuration viewpoint should be opened to these industries. Industries B and P are not yet covered based on the analysis. These industries open both conceptual and empirical studies – both industries as relatively homogeneous fields may find remarkable advantage when studied from configuration perspective. Totally new industries represented by X, is especially interesting area to look at, when the future of configuration research is considered. Case studies as well as conceptual studies may provide fresh viewpoints for the configuration perspective.

The industry specific approaches can provide powerful tools for growth management in specific industry contexts. These businesses have found only little support from universal frameworks. For the research, this may encourage opening new industrial contexts from configuration viewpoint, and encourage to deeper analysis of the contexts earlier studied.

Focus processes – the commonalities and trends

The analysis of the focus processes is based on widely known APQC Process Classification Framework (APQC PCF) (See 2). APQC PCF provides a detailed taxonomy of business processes derived from the joint effort of U.S. businesses. It consists of 5 operating processes; development of vision and strategy (1), design and development of products and services (2), marketing and selling products and services (3), delivery of products and services (4), and management of customer service (5), and 7 management and support processes; development of human capital (6), management of information technology (7), management of financial resources (8), acquiring, constructing, and managing property (9), management of environmental health and safety (10), management of external relationships (11), and management of knowledge, improvement and change (12). Each main process is divided into sub processes. Each configuration study was analyzed using the PCF main processes as a selective lens to identify the primary process areas each study seeks to contribute to.

Growth is a change process occurring over time (See i.e. 38; 39). In fact, every configuration study analyzed for this study include change viewpoint – in the APQC PCF, the change process is one part of the process number 12, Management of knowledge, improvement and change. As growth is seen fundamentally as change process it is important to discuss some potential viewpoints to change. According to (7) the nature of change can be seen from different perspectives. One perspective handles organizational change as pervasive and continuous phenomenon while the other perspective handles organizational change as discrete and episodic. For example (37) view organizational change as permanent feature of organizations, having neither beginning nor the end and emerging from the complex interaction of individuals within an organization and the evolving environment. On contrary, organizations can be seen fundamentally inert (17). Further, and more complicated, some authors view organizational change as punctuated (See i.e. 33). Each of these three perspectives highlights one dimension of change. The decisions related to growth are future oriented. The second relatively important process that was considered in majority of these studies is process number 1 in APQC PCF, Development of vision and strategy. More than 80% of the studies focused on this process. The following processes that the studies focused relatively frequently are 6, 3, 11, 8, 4, 2, and 7. Only a few studies focused on the rest of the processes described in the APQC PCF. These are 5, 10, and 9.

The focus processes vary between the three groups of analysis. The focus processes inside early, central and recent studies are compared in the figure 4. In the early studies the focus is on quite narrow number of processes. Only four processes can be found. The processes are relatively general processes. Among the operating processes the studies focus on the first two ones, development of vision and strategy and design and development of products and services. Among the processes related to management and support services, the studies focus on development of human capital, and the management of knowledge, improvement and change. This reflects the relatively early development of the configuration research. The most general and key processes are detected first in these studies. In the central studies the focus of

the configuration models is broadened. 10 of the main processes presented in the APQC PCF can be considered as focus processes. The models already cover all of the operating processes and among the processes inside the management and support services, only the property management process and the management of environmental health and safety are not covered. The group of recent studies covers all the processes of APQC PCF to some extent.

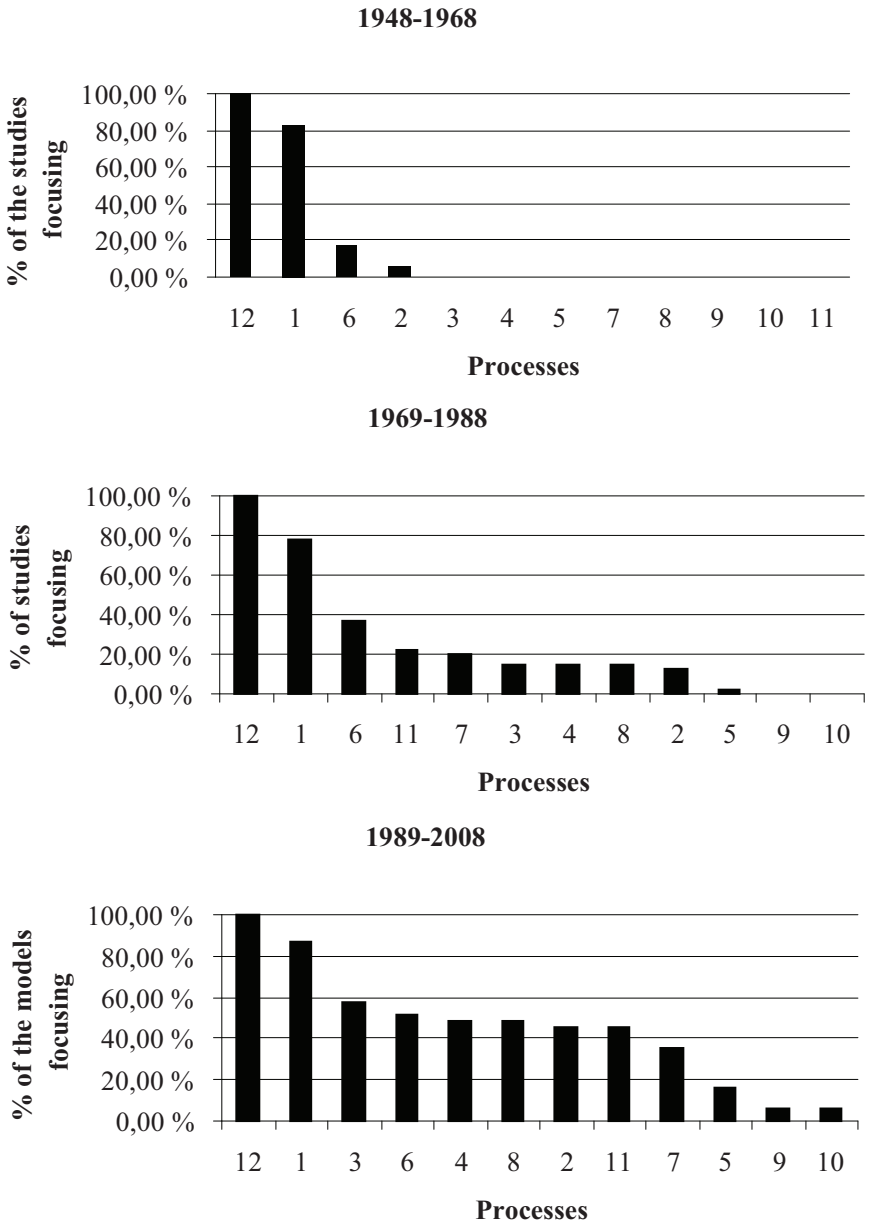

Fig 4. Focus process – the commonalities and trends

The Figure 4 clearly shows how the configuration viewpoint has evolved through the 6 decades under analysis. The first relatively general viewpoints in early studies form a basis for the development of more detailed analysis inside central studies and the recent studies. The central studies already start to focus on the operating processes while the later studies go deeper into that analysis. The similar phenomenon is seen when the management and support services related processes are analyzed. The central studies turn the focus from general analysis of just a few processes towards a broader viewpoint into management of information

technology, financial resources, and external relations. The recent models add management of environmental health and safety and property management and build deeper insight into the processes earlier addressed.

As analysis of configuration studies moves through these six decades, every key process area mentioned in PCF is covered to certain extend. This reveals the trend of diversification among the configuration models. In the early studies only few key processes are covered, while the recent models – at least to some extent – cover all the processes of PCF. The most of the processes were noticed already among the central studies but studied deeper in the recent studies. Both the operating processes, and management and support processes are covered. Some studies focus on multiple processes while others are strictly focused to one or two process. However two processes 1 and 12 have attracted the interest of the configuration research. These are the first and the last processes mentioned in the APQC PCF. These are the fundamental processes in configuration studies. These processes seem to stay at the focus of the configuration viewpoint throughout the six decades and further on. It is interesting to see how the configuration studies move to other focus processes as the field matures internally. The diversification of the field opens new viewpoints and provides sharper picture of each process area across the stages of development. At the same time must be addressed, that the development of the configuration viewpoint is affected by the development of the process viewpoint – this is an external trend that has affected and still affects the configuration studies.

Implications from the analysis of focus processes

The configuration perspective already provides relatively detailed and empirically based process-specific analysis when the most commonly studied processes 1 and 12 are considered. When these processes are considered in the future studies, there are some viewpoints to be considered. First, each main process of APQC PCF analyzed here consists of sub-processes which offer much potential. Process 12 consists of knowledge management and change processes. In this analysis, the change process is noticed as an important part of every configuration study – however, the knowledge management process is at the focus of only a few studies. Process 1 consists of definition of the business concept and long-term vision, strategy development, and management of strategic initiatives. The sub-processes of the APQC PCF framework provide many interesting viewpoints to be studied from configuration perspective. Second, the processes 3, 6, 4, 8, 2, 11, and 7 mentioned relatively frequently lack empirical analysis. There is a need for empirical testing of the typologies in this group and especially for empirically based taxonomies. Third, some configuration studies seem to cover many processes, but lack in-depth analysis of these processes. Many of them are only conceptually analyzed ore described on very general level. There is a lot of potential for the configuration studies focusing on single process or small group of processes.

Some processes are found relatively in smaller group of studies and more recently added to the configuration perspective. Many of the studies analyzed here describe or mention many processes without really focusing on that particular process – this provides opportunity for studies focusing on single process. Many of these processes could be separately analyzed to gain deeper understanding from configuration perspective. Some processes, such as 5, 9, and 10 are only recently added to the configuration perspective, and lack of deeper conceptual and empirical analysis. The process number 5 is latest of the operating processes found in configuration studies – and closest to the customer. Interest towards process 5 has already

increased, but each one of these still includes much potential for further conceptual and empirical research. Processes 9 and 10 lack analysis from configuration perspective – both could be empirically studied to clarify how growth affects the management of these processes in the early stages of business development.

For the academic research, the analysis of the configurations inside specific processes may open new interesting research areas – this leads to more accurate understanding of the early development of processes in the companies. There is still potential a for in-depth empirical analysis among the more frequently mentioned processes. Anyhow, the need for universal configuration studies could be questioned. There are many processes that have not yet been carefully studied from configuration perspective. Among these configuration research may find much potential for further conceptual and empirical research.

DISCUSSION

This study intends to clarify two viewpoints in 90 configuration studies published during the past 60 years; the industry focus and the process focus of these studies. First the configuration studies related to growth of private profit seeking companies are identified and grouped into three periods of analysis. Second, the focus industries and processes are studied in order to identify commonalities and trends. Third, some implications for the future research are presented. The extensive sample of configuration literature provided here can encourage for interesting new levels of analysis among configuration literature.

As the focus industries were analyzed according to SIC, two main shifts were addressed. First, the main shift is from general studies to industry context specific studies, and second, the industry base among the recent studies is remarkably wider than in two earlier ones. These two dramatic shifts are taken between the central and the recent studies. The industry is unique – some of the configurations are unique inside a certain industry leads to a need for industry-specific configuration studies. The natural shift was taken in the late eighties and early nineties to address the need. On the other hand, the industries continue to diversify and new challenges arise in terms of the applicability of the earlier studies to the most recent industrial contexts. The current trend seems to lead both towards more in-depth studies focusing the industries earlier addressed and studies focusing on new industrial contexts. The industry specific approaches can provide powerful tools for growth management for the companies in specific industry contexts. These businesses may have found only little support from the former, more universal frameworks.

Based on the analysis of focus processes, every key process area mentioned in APQC PCF is covered to certain extend. This reveals a trend of diversification among the configuration models. In the early studies only few key processes are covered, while the recent models cover all the processes of PCF to some extent. Both the operating processes, and management and support processes are covered. Some studies focus on multiple processes while others are strictly focused on one or two process. Anyhow, two processes have attracted the interest of the configuration research, the development of vision and strategy and the management of knowledge, improvement and change. These are the fundamental processes staying at the focus of the configuration viewpoint throughout the six decades – and further on. As the field matures, the configuration studies broaden the perspective to other processes. This diversification of the field opens new viewpoints and provides sharper picture of each process area across the stages of development. The configuration viewpoint is affected by the

development of the process viewpoint – this external trend has affected and still affects the configuration studies. Increasing understanding of the processes provide companies opportunity to manage its processes according to the stage configurations most common to the specific processes. Each process area needs specific attention as company grows.

This study provides some implications for the future research. *First,* some business contexts have found only a little support from universal frameworks. The analysis identified potential new industry contexts to be focused in the future research. Hopefully, this encourages academic researchers to open new industrial contexts from configuration viewpoint. *Second,* the analysis reveals a need for deeper analysis of the contexts earlier studied. Inside the most commonly mentioned industries can be found many subcategories that potentially do not find relevant support from configuration studies yet. More in-depth research is needed. The other often mentioned focus industries could be studied more empirically – especially empirically based taxonomies are needed. *Third,* analysis revealed industry contexts that the configuration perspective could find more fresh context-specific challenges. The new industrial contexts should be opened from configuration viewpoint – both conceptual and empirical studies could be considered. *Fourth,* the analysis of the configurations inside specific processes open new interesting research areas. There is still potential a for in-depth empirical analysis among the more frequently mentioned processes. Fifth, there are many processes that have not carefully been studied from configuration perspective. Among these, configuration research may find much potential for further conceptual and empirical research. *Fifth,* concerning both focus industries and processes, the need for universal configuration studies can be questioned based on this study. The universal frameworks have been generated in large numbers – however, it seems that these can provide only limited industry and process specific support for the companies. Based on this analysis both the industry context and process focus should be defined more clearly in the future studies.

This study is primarily addressed to the scholars interested on the process perspective on company growth and development. The analysis presented here is a starting point rather than the end in itself. As presented in the introduction, this study is limited on the analysis of the two key attributes, the focus industries and focus processes. Growth is a multidimensional and heterogeneous phenomenon, but still the effects of growth need to be managed in the companies. There are several limitations to be addressed. To some extent this study is interpretative. As some attributes studied were not directly addressed in every study of the sample, some subjectivity needs to be accepted. This study is meta-analytical in nature and in this sense does not contain any preliminary or secondary data. The data of this study consists of the company focused configuration studies collected among the six latest decades. One challenge in the meta-analysis of the configuration viewpoint is that the primary data is sometimes missing from the study. Further, only a certain proportion of the models can be considered to have empirical evidence and smaller portion can be considered as taxonomies. In the following analyses, the results of the empirical studies could be compared with the conceptual ones to see if there is more consistency among the studies addressing both theoretical and empirical context than among the rest of the studies. This study is limited to the configuration studies published between 1948 and 2008. Confidently can be said that reasonable proportion of the widely accepted configuration studies published during the last six decades are included into this analysis.

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APPENDIX 1:

The early studies (1948-1968)	The central studies (1969-1988)	The recent studies (1989-2008)
Whyte 1948	Steinmetz 1969	Hasenfeld & Schmid 1989
Fayol 1949	Rhenman 1973	Kazanjian & Drazin 1989
Davis 1951	Scott 1971	Adizes 1989
Drucker 1954	Greiner 1972	Kazanjian & Drazin 1990
Newman & Logan 1955	Mintzberg 1973	McCann 1991
Herbst 1957	Kroeger 1974	Hanks et al. 1991
Moore 1959	Torbert 1974	Dodge & Robbins 1992
Haire 1959	Stanworth & Curran 1976	Hanks et al. 1993
Filley 1960	McGuire 1976	Hanks & Chandler 1992
Chandler 1962	Thompson 1976	Terpstra & Olson 1993
Christenson and Scott 1964	Abernathy 1976	Hanks & Chandler 1994
Collins et al. 1964	Hosmer et al. 1977	Dodge et al. 1994
Blake et al. 1966	Normann 1977	Eggers et al. 1994
Katz & Kahn 1966	Parks 1977a, Parks 1977b	Flamholtz 1995
Starbuck 1966	Gervais 1978	Garnsey 1998
Buchele 1967	Lavoie & Culbert 1978	Gudmundsson 1998
Lippitt & Schmidt 1967	Robidoux & Dell'Aniello 1978	Poutziouris et al. 1999
Cannon 1968	Adizes 1979	Gartner & Brush 1999
	Minzberg 1979	Mitra & Pingali 1999
	Cooper 1979	Shim et al. 2000
	Kimberly 1979	Abetti 2001
	Schollhammer & Kurifoff 1979	Beverland & Lockshin 2001
	Filley & Aldag 1980	Jawahar & McLaughlin 2001
	Scanlan 1980	Hite & Hesterly 2001
	Aplin & Cosier 1980	Kuratko & Hodgetts 2001
	Naoum 1981	Ndonzuau et al. 2002
	Galbraith 1982	Swiercz & Lydon 2002
	Perry 1982	Kaulio 2003
	Churchill & Lewis 1983	Rutherford et al. 2003
	Quinn & Cameron 1983	Zadek 2004
	Tyebjee et al. 1983	Garengo & Bernardi 2007
	Mintzberg 1984	Stam 2007
	Miller et al. 1984, Miller & Friesen 1984	
	Vargas 1984	
	Van de Ven, A.H. et al. 1984	
	Smith et al. 1985	
	Flamholtz 1986	
	Olson 1987	
	Scott & Bruce 1987	
	Baird & Meshoulam 1988	
	Kazanjian 1988	

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A SIMULATION ANALYSIS OF GROUP TECHNOLOGY AND JOB SHOP MANUFACTURING SYSTEM

Surat Triwanapong, Kasetsart University, Thailand
g4985026@ku.ac.th

ABSTRACT

This paper presents a study performed to compare the performance of Group Technology and Job Shop Functional Manufacturing system in two significant environmental factors: through-put and flow time. The factors included in the study are demand, processing time, set-up time, and lot size. This study employ simulation model to evaluate the effects of these factors on the performance of the system and produce six lot size levels. The performance evaluation function is defined in terms of the average flow time of all the part types through the manufacturing system. Arena10.0 simulation software is used to measure the main effects and interactions between these factors. The results contrast the effectiveness of two manufacturing approaches under differing input conditions. Shows the choice between Group Technology and Job Shop Functional Manufacturing system on through-put and lot size.

Keywords: Group Technology, Job Shop Functional Manufacturing system, simulation model, through-put, flow time

INTRODUCTION

Group Technology concepts were introduced by Mitrofanov (1959) with the goal of identifying similar attributes of objects (parts) to be produced. One of the most successful application of these concepts is the so called Cellular Manufacturing. Agawal *et al.* (1995) emphasized comparative of the performance of job shop functional and cellular manufacturing (CM) layout. Generalizations concerning the impact of inter-cell movements, reduced variability in job arrivals and processing times, and move time factors on CM performance are difficult to make. The benefits have resulted in significant reductions of WIP, set up time, lot size, lead time, and cost of new part introduction. Mubaraka *et al.* (2003) focused cellular manufacturing (FCM) that group component and form cells of machines in order to assembly. The results indicate that the FCM scheme has batching advantage that dominated the balanced machine utilization benefit of the job shop functional layout scheme. Kannan and Palocsay (1999) used queuing theory to illustrate the relationship between processing time learning rates and flow time performance in cellular and job shop. Models are developed that make it possible to estimate the learning rate required in a cellular shop in order for it to yield performance comparable to that of a job shop. Simulation is used to validate the models under dynamic conditions as opposed to the steady state conditions assumed by queuing theory. Banu *et al.* (2008) employed simulation to evaluate the effects of factors of two different plant layout types, namely job shop functional layout (JFL) and cellular manufacturing layout (CML), as well as scheduling rule, machine downtimes, batch sizes, and transporter (inter stage transporter) capacities on the performance of the system and then conduct designed experiments to set the best levels of these factors. The performance

evaluation function is defined in term of the average flow time of all the part types through the manufacturing system. According to Selim *et al.* (1998), this approach represents a hybrid between Job Shop and Flow Shop production system. Referring to Askin and Standridge (1993), a manufacturing designer through group parts concepts aims at obtaining the advantages of flow line systems in environments previously ruled by job shop procedures.
This paper compares job shop manufacturing and cellular manufacturing by explicitly modeling throughput as an output in the analysis. Using simulation models for each manufacturing structure, this study yields the flow time and lot size characteristics under which each is superior to the other. The study also yields those conditions under which there is no significant difference in the output between the two manufacturing structures.

Background of the research

Cellular and job shop functional manufacturing systems are two alternate ways of organizing the production. Many firms have recently switched from a functional type production system to a cellular type to gain competitive advantages. Several companies which have implemented cellular manufacturing claim that the new system results in reduced handling time, setups, throughput times and work in process inventory. The principal difference between a job shop functional layout (JFL) and a cellular manufacturing layout (CML) is the pattern of work flow. CML involves the grouping of parts that have similar processing requirements into part families, while JFL has grouped machines by function (i.e., all the lathes together, all the mills together, etc.).

Huq *et al.* (2001) carried out a simulation analysis to identify the factors influencing the average flow time and throughput performance of job shop functional and cellular layouts. Their simulation models produce robust results which contrast the effectiveness of the two manufacturing approaches under varying input conditions. They showed that the choice between the job shop functional structure and the cellular structure significantly affects throughput for lot sizes up to 55, while for lot sizes of 60 and above there is no significant effect. Furthermore, if companies need to move to a cellular set up from their present job shop environment or job shop functional set up, they must significantly cut down their set up times by at least 60-70 percent in order to be able to move to the next stage in the JIT system and move the machines into a cellular.

The research conducted by Agawal *et.al* in 1995 has been done in comparing of the performance of job shop functional and cellular manufacturing layout. They reviewed identifies gaps in comparative performance literature on cellular and job shop functional manufacturing systems. A reviewed of the research within the three methodological categories as: Simulation studies, Empirical studies, and Analytical studies.

Group Technology is essentially designed to improve the efficiency of small batch production. This manufacturing structure is best suited to the multi-product manufacturing company whose production volume does not justify continuous or mass production. The principal difference between a shop operating on a functional basis as opposed to one operating on group technology

(cellular manufacturing) lies in the machine layout and the pattern of workflow. Cellular manufacturing involves the grouping of parts that have similar processing requirements into part families. However, cellular manufacturing seeks to achieve many of the efficiencies associated with mass production in job shop or functional manufacturing system .(see Edwards,1974).

Even though a large number of articles suggest that group technology has revolutionized batch manufacturing, studies such as Flynn and Jacobs (1987) and Morris and Tersine (1990) question conclusion of superiority of cellular manufacturing structures over job shop functional manufacturing. In contrast to Burbridge (1992), Rathmill and Leonard (1997) suggest that an efficient job shop functional manufacturing structure is superior to a cellular structure.

Several researchers identify set up time reduction as very important in reaping the benefits of converting to a cellular layout (see Fynn and Jacobs, 1987, Shafer, 1990, Suresh, 1992). Suresh includes lot size in analyzing the choice of manufacturing structure on flow time.

This study using a simulation model analyses flow times for each of the manufacturing structures. That is, compared with the job shop functional structure, the cellular structure may improve flow time but not through put in a case electric motor company.

Simulation model

The analytical models for the cellular layout system and the functional layout system presented are consistent with the purposed by Suresh (1992). Figure I presents the M/M/1 queue with *s* single servers characterizes the partitioned system, while figure II presents the M/M/C queue with multiple servers characterizes the un-partitioned system. Flow time provides a confirming exercise for Suresh's results, more importantly, using through put provides a performance metric more closely aligned to a demand pull environment.

The operating characteristics for the mathematical bases form the simulation model. The fixed input variables are the number of similar machine (s), the demand rate (d), and average process time (t). The input variables under study are the lot size (q) and the set up time as varied by the set up time reduction factor (S):

$$P_0 = \left(\sum_{n=0}^{s-1} \frac{\left(\frac{\lambda}{\mu}\right)^n}{n!} + \frac{\left(\frac{\lambda}{\mu}\right)^s}{s!}\left(\frac{s\mu}{s\mu-\lambda}\right)\right)^{-1}$$

Where λ = arrive rate, μ = service rate, δ = set up time reduction factor, T = set up time. One of the ways in which benefits of cellular manufacturing can be reaped in a partitioned system is via set up time reduction. Furthermore, for any given lot size, an un-partitioned system performance measure, through put. Through put time captures set up times, thereby moving the performance measure closer to a demand response metric. To compare cellular system with functional

systems, this study builds a simulation model using flow time and through put performance measures.

Figure I : Single Queue in Cellular Manufacturing

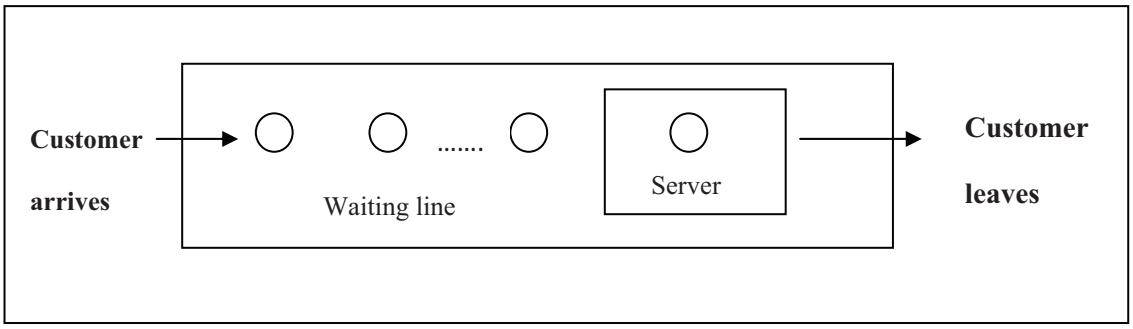


Figure II: Multiple queue in Job shop functional Manufacturing

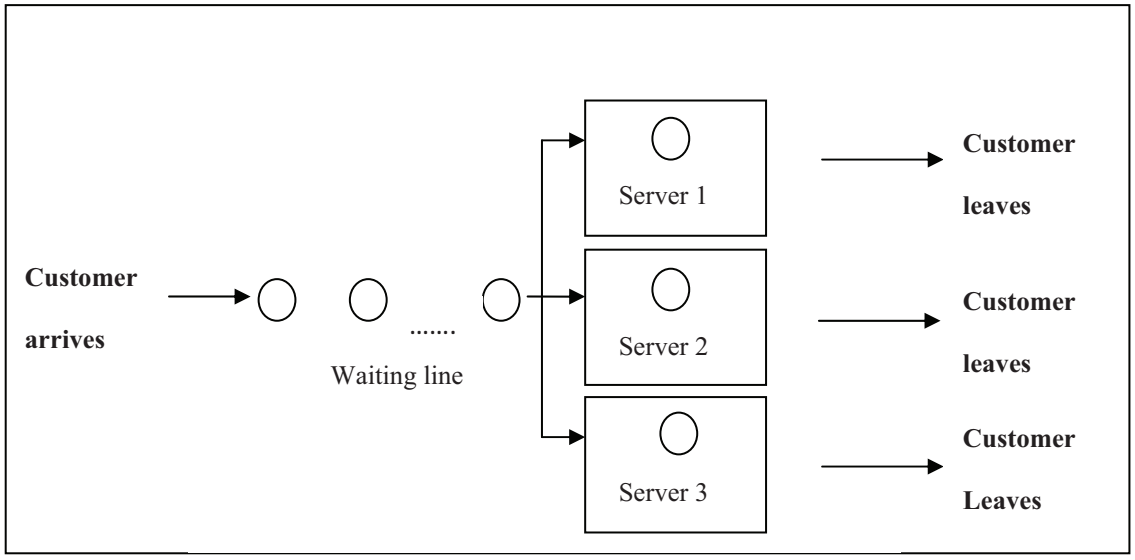
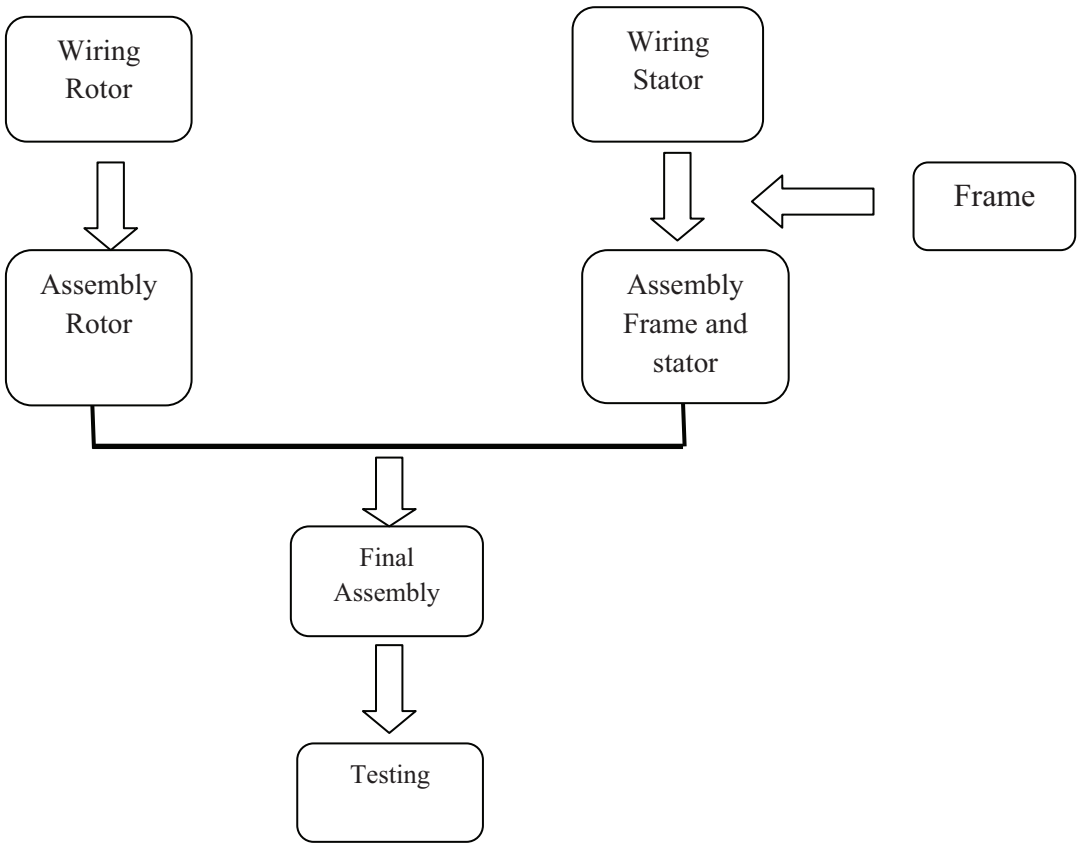


Figure III presents the electric motor manufacturing process that beginning from wiring rotor with shaft assembly then assemble rotor in punching plate laminate. On The other hand wiring motor stator. After that assemble the frame and stator. Furthermore, both of rotor and stator assemble in final assembly. Finally, painting and testing motor. The processing time of each operation as shows Table 1. In the job shop layout system jobs arrive randomly at the first work center, which group machines 1, 2, 3, all the same type. The jobs enter a queue, if all the

machine are busy, or proceed to be processed, if the machines are free. If the machine has already been set up for that similar part-type, then the only time spent is the processing time at the machine. If a different part was previously set up, then the machine processing time will include set up time and processing time. Jobs wait in queue until a busy machine becomes available. The moment a first machine becomes available, a job moves to that machine and the number in queue decreases by one.

Figure III : Electric motor process



Any machine of similar type can be set up any type of part and this flexibility prevents long queues for available machines. One the job completes processing at the first work center, it joins the second work center, machines 4, 5, 6. If machines at the second work center are available, then any set up requirement is determined. If setting up is not required, the jobs proceeds and processing time is recorded. If set up is required, the processing time for the job will include the set up time and the processing time. The jobs run through a similar sequence of operations at the third and fourth work centers. Once the jobs complete processing at the fourth work center, their number is added to the total number of processed jobs or finished goods completed (through put). This model assumes only unidirectional flow of jobs and no backtracking. Processing time

for a particular job includes this inspection time. The amount of time the job spends in the system is the flow time. Flow time includes the time from arrival at the first work center until the job's departure after processing at the fourth work center. The model includes the assumption that the inter-arrival time between jobs is exponentially distributed with a mean of 60 minutes. In the simulation experiments using functional job shop models, the set up time in rotor assembly and stator assembly is based on triangular distribution varying between TRIA (25,30,35) and TRIA (30,45,60), respectively. For transportation between operations is based on 10 minutes.

Table I: Processing time of motor manufacturing

Operations	**Processing time**
Wiring Rotor	TRIA(50,60,70)
	TRIA (65,70,75)
	TRIA (65,75,80)
Assembly Rotor	TRIA (40,50,60)
	TRIA (60,75,85)
	TRIA (55,65,75)
Wiring Stator	TRIA (45,50,60)
	TRIA (75,85,90)
	TRIA (35,50,65)
Assembly Frame and stator	TRIA (35,45,60)
	TRIA (60,70,80)
	TRIA (55,65,70)
Final Assembly	TRIA (60,75,90)
Testing	TRIA (60,70,80)

The manufacturing layout for the cellular layout system that is achieved by partitioning the job shop functional layout system. Cellular layout system consists of three designated cell. Each

dedicated to a part family. There are three part families, each containing one product type. Each cell of part family consists of six operations. In the cellular layout system jobs arrive randomly at the first machine center for each cell.

The jobs enter in lot sizes which are consistent across the three cell part families. The inter-arrival time between jobs is exponentially distributed with means 60 minutes for each cell. The jobs enter a queue, if the machine center is busy, or proceed to be processed, if the machine center is available. The machine centers (cells) are dedicated for a particular part-type or product-type, belonging to the specific family associated with the cell. If the machine has already been set up for that similar part type, then the only time spent is processing time at the machine. If a different part was previously set up, then the parts processing time will include set up time and processing time, jobs wait in queue until a machine is available. The moment the machine center becomes available, a job is directed at that machine and the number in queue is reduced by one. All the jobs belonging to a particular family run through the same sequence of machine centers in the cell. Queues tends to form before machine centers in cellular set ups, unlike job shop functional systems where queues exit before the work centers. Once the job completes processing at the first machine center, it joins the queue at the second. If the second machine center frees up, then it is ascertained if the machine center is already set up or needs to be set up. If it does not need to be set up, then the job is processed and the processing time for the job will include the set up time and processing time. The jobs run through a similar sequence of operations at the third and so on. Once the jobs complete processing at the final operation of the cell, their number is added to the total number of processed jobs or finished goods completed. The model assumes unidirectional flow and no backtracking. The operators inspect the parts before running them through the next machine center. Processing time for a particular job includes inspection time.

Experimental design

The aim of the simulation experiment is to compare the cellular performance with the job shop performance using through put and flow time performance metrics. The variables input factors is lot size and the fixed input factors are the number of machines of similar types, demand rate, and process time. The simulation experiment uses the metrics through put and flow time to contrast performance of a cellular layout system with job shop functional layout system. The experiment assumes a high level of cell independence and a given part is processed completely within one cell. The simulation experiment involves 6 batch sizes of the variable input factors, wherein a number of cellular modes are compared with a fixed job shop functional varying lot sizes. The experiment considers a hypothetical shop consisting of 6 operations with three machines of each type, processing three part-types or product types. This assumes that the parts belong to three families, based on similarities in routing and tooling requirements. Each family has one part or product-type.

The amount of time the jobs spend in the system in the flow time. It includes the time for the arrival to the first machine center until the job's departure after processing at the final operation. Analysis of the simulation output shows that the steady state condition is reached when the program is run for 72000 minutes (6 months). A run length of 72000 minutes was found to provide an adequate of job as well.

Results and discussion

The flow time, throughput and waiting time of job shop functional manufacturing and cellular manufacturing present in Table II, Table III and table IV, respectively. The values presented in Table II and III are the means values for the two dependent variables: flow time and throughput for the several of batch size.

Table II: Flow time simulation results

	Batch size					
	10	20	30	40	50	60
Job shop	32459	27618	27689	22910	23380	24365
Cellular	7282	3771	6112	5653	4258	5311

Table III : Throughput simulation results

	Batch size					
	10	20	30	40	50	60
Job shop	52	50	40	42	36	32
Cellular	232	114	72	56	44	40

Table IV: Waiting time simulation results

	Batch size					
	10	20	30	40	50	60

Job shop	520	1123	1723	2317	2958	3505
Cellular	4837	10466	16633	21940	27474	31763

The range of values for the batch size was between a minimum of 10 to a maximum of 60. In this case, average flow time spent in system and throughput of cellular manufacturing superior performance over job shop functional manufacturing, but waiting time of cellular has longer queue than job shop system.

CONCLUSION

As a result of comparing between job shop functional manufacturing and cellular manufacturing in electrical motor manufacturing, it was concluded that cellular manufacturing has high performance value of flow time and throughput than job shop system. However, the study does not concern amount of set up time that affects of both systems. Further study to extension the effect of varying jobs arrival on the performance measures of flow time and throughput. A sensitivity analysis by varying the processing times and observing its impact on the performance measures of flow time and throughput.

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THE DETERMINANTS OF FOREIGN DIRECT INVESTMENT IN CAMBODIA: CASEE STUDY OF MULTIENTERPRISES

Mr. Sivyong HO, Mae Fah Luang University, Thailand
hosivyong@yahoo.com

ABSTRACT

The study focuses four main factors such as marketing factors, cost factors, investment climate factors, and other factors. The model is based primarily on incorporating OLI model of Dunning, Czinkota and Rokainen (2001), Gilmore Gilmore et al., (2003), and Mansfield (1994). While the problem being faced by the foreign investors in Cambodia which are examined by 21 potential factors. The research is analyzed on the basic of qualified 128 questionnaires that are collected from various industries.

The main findings in this research, regarding to the determinants of foreign direct investment in Cambodia, indicate that marketing factors, cost factors (lower unit labor cost, labor skill, accessibility to raw materials, transportation cost (local and oversee) and acquisition of technology (R&D)), investment incentive factors and other factors, have a positive relationship with the foreign direct investment in Cambodia. In addition, regarding to the problems of doing business in Cambodia, the research also find that labor skill, local technology (R&D), are the most problem area for the foreign investors in Cambodia.

The findings of this study lead to recommend that the Royal Government of Cambodia should focus and seek to improve in human resource development (HRD). The researcher recommend to the Royal Government of Cambodia to support the foreign firms by reducing some administration procedures (transaction costs); encourage education through the training; retraining; provide more incentive and open market through negotiating and requesting for GSP granted or import duty free from developed countries to secure the market access.

Keywords: Foreign Direct Investment, Multinational Enterprises, Human Resource Development.

INTRODUCTION

The Importance of Foreign Direct Investment

Investigation on globalization of markets and internalization of companies is a phenomenon of growing interest in current research. Foreign direct investment can be formed as incorporate wholly-owned foreign investment, which is the creation of a wholly-own subsidiary through either acquisition or setting up a new operation on a Greenfield site in which they invest and engage in various decision making activities (Geringer & Hebert, 1991). Foreign direct investment dose not only penetrate the host country market, but also gains access to raw materials, labors and other resources. Furthermore, the company rationalizes the production process as well as diversifies its business.

Inward FDI of Cambodia has progressed rapidly in 1990s and early of 2000s. Since the country gains benefit from peace and political stability as well as incentive investment law. However, the lack of indigenous capital and technology, measure for attraction of foreign investment and promotion trade are vital parts of industrial policy in Cambodia. While the

government of Cambodia has adopted policy for promotion of export based on its resources (natural resources, agricultural and livestock products, and marine products) and has posted the supply of low-cost labor as an investment advantage. It is also found that Cambodia has offered incentives for sitting by labor-intensive industries.

In 1995, shortly after the enactment of law for attraction of foreign investment, MNEs are playing a key role in the current globalization process. World FDI inflows stood at $ 560 billion in 2003, continuously decreasing since a peak in 2000 (UNCTAD, 2005). FDI flow into Cambodia began increasing in the early 1990s. However, the amount itself did not continuously over the years. For example, total inflows were roughly $150 million both in 1995 and 2002. In 2006 and 2007, the figure has rapid increased by $4.41 and 2.67 billion, respectively (CDC source, 2008).

The question of how to revitalize FDI flows to developing countries is all the more relevant today, as expectations are focused increasingly on FDI inflow to developing countries such as Cambodia, as the need of country for financial, technical, and entrepreneurial resources. Attempts to alter the external financing structures of some of these countries toward increasing the role of transfers involving risk and profit sharing may suffer. In order to overcome constraints in the supply of FDI, the determinants of FDI flows have to be identified in the first place. The intent of the present study is therefore to identify determinants of FDI flow into Cambodia.

As the country has just emerged from warfare and the return of the peace and receives Generalize System of Preferences (GSP) and Most Favored Nation (MFN), Cambodia has been seen again as investment market in the world. Cambodia, with its preferential trading status, low wage structure and abundant labors, offers a potentially attractive home for foreign investor in the form of the flow of FDI in the fields of garment industry, tourism, lighting and electronic industry and agriculture. In order to attract foreign direct investment, the Royal Government of Cambodia has strengthen the political stability, open to free economic market and law and regulation on investment has been enacted to secure the investment guarantee and investment incentive.

Without FDI Cambodia may not survive. By seeing the important role of FDI in developing the poor economy of this country, the investigation try to explore the other more determinants of the FDI such as technology (R&D), labor cost, labor skill; and the current problems in conducting business and finally explore the performance of foreign direct investment in Cambodia.

LITERATURE REVIEWS

A Review on the Determinants of Foreign Direct Investment: Theoretical and Empirical Perspectives

There is a fairly large number of researchers which have been devoted to the analysis of the determinants of FDI (Vernon 1966; Dunning 1993; Czinkota & Ronkainen, 2001; Gilmore et al., 2003). Although there is no consensus among researchers as to a consistent set of factors, the following three are usually viewed as determining the FDI inflow: (1) low labor cost, (2) labor skill and, technology transfer.

The lower labor cost in the host country, as indicated by Vernon's product cycle hypothesis (1966) which states that based on the comparative advantage arising from the pattern of factor endowments; initially a product becomes standardized or mature and labor (un-skill and skill) becomes a more important ingredient of production costs, the attractions of sitting value-adding activities in a foreign, rather than in a domestic, location increase. In addition, the factors deciding the location of the foreign direct investment involve labor costs; marketing factors, trade barrier and government policy (Hood & Young, 1982). At the same time, other researchers have come to the conclusion showing the reverse effect, meaning that high salaries have a negative impact on the flow of FDI (Gilmore et al., 2003). Last, many companies conduct FDI to increase the availability of labor to expand internationally by cutting costs is to enter a foreign market that presents the company to lower labor (Czinkota and Ronkainen, 2001 & 2005).

The skill labor has also been viewed as a choice of host market (Dunning, 1980), for example, has conducted research showing that higher wages reflect a more productive workforce and associated with increased foreign investments. (Gilmore et al., 2003)which suggest that the cost of labor has been more extensively explored in the FDI literature and the research has produced mixed feelings, they urge that the human resources the single most important factor is to what the education of the workforce are comparable to the needs of the specific company. Furthermore, firms often seek to increase their cost efficiency by transferring production, totally or in part, to low labor costs locations. This is especially likely to happen in industries where unskilled or semi-skilled labor represents an important part of the production costs (Dunning, 1994).

The technology transfer could also influence the inflow of FDI into Cambodia. As a product was invented in the home country with comparative advantage in technology and innovatory capabilities, and produced for the home market in the home country near to both its innovatory activities and markets Vernon, 1966. A firm's ownership advantage could be a product or a production process to which other firms do not have access, such as a patent or blueprint. It could also be some specific intangible assets or capabilities such as technology and information, managerial, marketing and entrepreneurial skills, organizational systems and access to intermediate or final goods markets (Dunning, 1993). Apart from Gilmore et al., (2003), explain that access to technology is considered to be one of the most important factors concerning investment location, and especially the ownership level of the investing company in today's globalize markets.

Furthermore, it is important to note that high levels of research and development expenditures are not necessarily connected to a high level of technological advancement. Moreover, many companies conduct FDI to increase the availability of labor to expand internationally by cutting costs is to enter a foreign market that presents the company to availability of capital/technology (Czinkota and Ronkainen, 2001 & 2005). Rugman and Hodgetts (2003) believe that there are seven major reasons, namely; increase sales and profits, enter rapidly growing markets, reduce costs, gain a foothold in economic blocs, protect domestic markets, protect foreign markets and acquire technological and managerial-know-how. Calagni (2003) suggests a demand for higher product quality has contributed to an enhancement of human capital. As capital investment often follows acquisition in such cases, in order to upgrade equipment and machinery, many employees are likely to require training. Moreover, indigenous managers are likely to enhance their knowledge through interaction with foreign managers, with some possibly benefiting from spending working periods abroad.

Lastly, foreign direct investment is an integral part of an open, international economic system and a major potential catalyst for development. This has been recognized by OECD in a report, which focused on maximizing the benefits for inward investment, while recognizing the possible costs and ways of reducing them. The potential benefits of FDI for host economies include increasing the supply of capital; technology and knowledge transfer; the generation of employment and human capital; as well as the effect on enterprise development, through linkages and spillover effects. In terms of technology and knowledge transfer, FDI in developing countries can potentially contribute to the upgrading of local suppliers through technical assistance, training and the transfer of knowledge. It may also contribute to increasing the rate of adoption of new technologies by local industries, as a result of processes of imitation and competition. In terms of employment, inward investors can generate new jobs directly, but they can also contribute to raising skill levels, because their skill requirements may be higher than those required by domestic firms. At the same time, the extent to which MNEs actually facilitate such spillovers in practice has been shown to vary between sectors and contexts (OECD, 2002).

In conclusion, the selected model in this study are modified verson of OLI model of Dunning (1993), and Czinkota and Rokainen (2001).

Empirical Models of the Determinants of Foreign Direct Investment

Model of Y. Ling and M. Szenberg

A study was conducted to empirically investigate the dynamic relationship between changes in macro-economic and micro-economic factors and changes in FDI made by Taiwan firms. The macro-economic determinants to be explored are (i) domestic saving-investment surplus, (ii) capital-labor ratio, (iii) labor supply, (iv) exchange rate movement, and (v) differentials in international interest rates and national economic growth rates. The empirical findings indicate that accumulation of capital, shortages of labor supply, establishment of a flexible foreign exchange system, export profits, market access to facilitate export, and foreign economic growth rate all contributed to the growth of Taiwanese FDI.

In the following model four specifications are examined using multiple regression analysis corrected for second order serial correlation, namely: linear, semi-log (mixed), log linear (multiplicative), and inverse linear (reciprocal).

The macro-economic hypothesis may be summarized as:

$$\mathbf{F = f(S, K, M, L)} \qquad \mathbf{(a)}$$

The micro-economic hypothesis may be summarized as:

$$\mathbf{F = g(R, \pi, G, I)} \qquad \mathbf{(b)}$$

Model 1

To test the macro-economic hypothesis summarized in Equation **a**, the following four model specifications are examined:

$$\text{FDI} = \beta_0 + \beta_1 \text{SSR} + \beta_2 \text{KLR} + \beta_3 \text{AMG} + \beta_4 \text{AGWP} + \beta_5 \text{D87} \quad (1)$$

$$\textit{Ln}\text{FDI} = \beta_0 + \beta_1 \text{SSR} + \beta_2 \text{KLR} + \beta_3 \text{AMG} + \beta_4 \text{AGWP} + \beta_5 \text{D87} \quad (2)$$

$$\textit{Ln}\text{FDI} = \beta_0 + \beta_1 \textit{ln}\text{SSR} + \beta_2 \textit{ln}\text{KLR} + \beta_3 \textit{ln}\text{AMG} + \beta_4 \textit{ln}\text{AGWP} + \beta_5 \textit{ln}\text{D87} \quad (3)$$

$$(FDI)^{-1} = \beta_0 + \beta_1 SSR + \beta_2 KLR + \beta_3 AMG + \beta_4 AGWP + \beta_5 D87 \quad (4)$$

where,
ln = represents natural logarithms, AMG = the annual manufacturing growth rate
FDI = the outward FDI, SSR = the surplus savings ratio
KLR = the domestic capital-labor ratio,
AGWP = the annual growth rate of the working population aged between 15 and 64
D87 = a dummy variable designed to capture the qualitative policy event of lifting of foreign-exchange (capital) control in 1987.

Model 2

To test macro-economic (business) hypothesis summarized in Equation **b**, the following four model specifications are examined:

$$FDI = \gamma_0 + \gamma_1 FXR + \gamma_2 PROFIT + \gamma_3 DIFG + \gamma_4 DIFR + \gamma_5 D87 \quad (5)$$
$$LnFDI = \gamma_0 + \gamma_1 FXR + \gamma_2 PROFIT + \gamma_3 DIFG + \gamma_4 DIFR + \gamma_5 D87 \quad (6)$$
$$LnFDI = \gamma_0 + \gamma_1 lnFXR + \gamma_2 lnPROFIT + \gamma_3 lnDIFG + \gamma_4 lnDIFR + \gamma_5 lnD87 \quad (7)$$
$$(FDI)^{-1} = \gamma_0 + \gamma_1 FXR + \gamma_2 PROFIT + \gamma_3 DIFG + \gamma_4 DIFR + \gamma_5 D87 \quad (8)$$

where,
FDI = indicates the outward-bound FDI, FXR = the foreign exchange rate,
PROFIT = the profitability index, DIFG = economic growth rate differentials,
DIFR = the interest rate differentials,
D87 = a dummy variable designed to capture the qualitative policy event of adopting a floating foreign-exchange system for the Taiwanese dollar (Dunning, 1998).

POTENTIAL PERFORMANCE OF FDI IN CAMBODIA

Based on the theories above, the potential factors and government policy toward FDI in Cambodia has been identified into market factor, cost factor, investment climate and other factors of Cambodia which will be more explained in the following paragraph:

Cambodia has a population about 14 million people, of whom 51% are in the "working age" group and over 60% of the workers are women. Cambodia's low labor costs are very attractive to investors. Labor costs are low compared with those in other Asian countries with the average out to only US$ 75 per month. The minimum wage in the garment industry is only $45 per month. Foreign companies are currently paying approximately US$100 to US$150 per month for non qualified workers with minimal English skills; US$200 to US$350 per month for workers with good English language skills and perhaps a higher education, and up to US$700 per month for bilingual and well educated employees. Investors generally found the Cambodian workforces trainable and motivated. Shortage of skilled employees was seen as a problem, although some investors acknowledged a modest positive trend in skill levels.

In addition, Cambodia is country with low technology in the processing manufacturing by using labor intensive in some industries. Meanwhile, the Cambodia has offered incentive to investors who provide training and development of human resources and the transfer of

technology and expertise to local staff. There is no other provision related to technology transfer.

RESEARCH METHOLODOGY

The principle purpose of this studying the determinants of FDI in Cambodia is to analyze and interpret data from questionnaire in order to examine the dynamic relationship between variables and the determinants of foreign direct investment into Cambodia such as ***Marketing factors*** in which are domestic market (local market growth, local market size), export base (GSP & MFN and ASEAN market); ***Cost factors*** in which are labor cost, labor skill, availability of natural resources (Raw material), transportation cost (domestic and oversea), technology; ***Investment climate factors*** in which are government incentive, government policy and protectionism (trade barrier), political instability and risk, economic policy, exchange rate, physical distance, culture proximity; and ***Other factors*** in which is intellectual property rights. The determinants which are internal and external factors influencing firms' foreign investment behaviors include business export profitability and other firm-level determinants.

This section describes the statistic indicating the important determinants of FDI in Cambodia, result of data analysis, hypotheses testing, interpretation, and problems faced by foreign firm operating in Cambodia. The model has been estimated by using SPSS 14.0.

Model Specification and Interpretation

The search for the best subset (such as adjusted mean squared error, adjusted multiple correlation coefficient, and the Cp statistic (Mallows, 1973)) can be improved by making assumptions on the evaluation function. The equations summarizing of variables of model specification are shown here for reference:

$$\mathbf{Y\ (FDI) = f\ (MAF,\ COF,\ INC,\ OTH)} \quad \mathbf{(4.1)}$$

To test hypotheses in Equation (4.1), the following model formula specifications are examined:

$$FDI = \beta_0 + \beta_1\,MAF + \beta_2\,COF + \beta_3\,INC + \beta_4\,OTH \qquad (a)$$

$$FDI = \beta_0 + \beta_1\,DoM + \beta_2 ExM + \beta_3 LLC + \beta_4 LSk + \beta_5 ANR + \beta_6 TrC + \beta_7 ATe + \beta 8 GoI + \beta_9 GPP + \beta_{10}\,EPo + \beta_{11}\,CCl + \beta_{12}\,IPR \qquad (b)$$

Where,

Y(FDI) : Foreign Direct Investment flow into Cambodia

MAF	**:**	**Marketing factors**	**INC**	**:**	**Investment factors**
DoM	:	Domestic market	GoI	:	Government incentive
ExM	:	Export market	GPP	:	Government Policies & Protectionism
COF	**:**	**Cost factors**	PIR	:	Politic Instability and Risk
LLC	:	Lower labor cost	EPo	:	Economic Policies
LSk	:	Labor skill	ExR	:	Exchange Rate

ANR : Accessibility to natural resource GCl : Geographic Closeness
TrC : Transportation cost CCl : Culture closeness
ATe : Acquisition of technology (R&D)
OTH : Other factors
IPR : Intellectual property right

AN EMPIRICAL STUDY OF THE DETERMINANTS OF FDI IN CAMBODIA

Modeling the Determinants of FDI in Cambodia

The mean of the opinion's score for each variable indicates the important level of that variable, which the S.D. indicates the deviation from the central value (Mean Score). Such variables can be measured, according to measurement of conducting questionnaire to scale the level of the importance of the determinants of the FDI in Cambodia as following**:**

Table 5.1: Descriptive Statistics of the respondents' opinions on the importance of the determinant factors

Cost factors	Mean	Std. Deviation	Important level
1- Low labor cost	4.4453	0.96235	Most important
2- Labor skill	4.0859	0.98034	High important
3- Acquisition of technology (R&D)	4.2969	0.96685	Most important

Table 5.1 shows the respondents' opinions on the important of cost factors to the FDI in Cambodia. It indicates that of all three variables are considered the most and high importances to the FDI in Cambodia. They are labor cost (mean = 4.4453, S.D. =0.96235) and acquisition of technology (mean = 4.2969, S.D = 0.96685) represent as the most important level, while labor skill (mean = 4.0859, S.D. =0.98034), represent as the high important level to the FDI in Cambodia.

Problems Faced by Foreign Firms of Doing Business in Cambodia

To investigate the problems faced by foreign investors in Cambodia, a strategy was adopted by the respondents being asked to rate them from 1(least problems) to 5 (most problem). According to measurement of conducting questionnaire to scale the level of the problem of each variable to the foreign firm facing in Cambodia as following:

Table 5.2 indicates the respondent's opinion on problems of cost factors faced by foreign firms operating in Cambodia. It indicates the high problems. They are labor skill (mean = 3.8359, S.D. = 0.81112), local technology (R&D) (mean = 4.1094, S.D. = 1.02898).

Table 5.2: Descriptive Statistics of the problems of determinant factors faced by foreign firms

Cost factors	Mean	Std. Deviation	Problem level
1- Labor skill	3.8359	0.81112	High problem
2- Local technology (R&D)	4.1094	1.02898	High problem

The main problems faced in Cambodia are electricity, legal system/bureaucracy, expiry of GSP in 2005, and the labor skill, local technology (R&D), are still challenged and the other problems that the investors are also concerned such as clarity and validity of information on investment, economic situation, insufficient of investment incentive, country image, tax regime.

Model of the Determinants of FDI in Cambodia and hypothesis testing

Statistical Results of Model 1

As the regression results of the model 1 (Table 5.3) indicate, lower unit labor cost is supported in terms of the relationship between cost factors and the FDI in Cambodia

The size of coefficient of lower unit labor cost is 0.177, means that if the lower unit labor cost increased by 1%, the FDI is increased by 0.177%, while the sign of the lower unit labor cost is positive (+), indicating the positive lower unit labor cost effect.

Table 5.3: Regression results for the determinants of FDI in Cambodia

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
(Constant)	(0.242)	(0.755)	(-0.143)	(-.152)
Local market growth	0.217 (2.415)	-	-	-
Local market size	-	-	-	-
GSP/MFN	-	-	-	0.184 (2.153)
ASEAN market	-	0.267 (1.463)	-	-
Lower unit labor cost	0.177 (1.790)	-	-	-
Labor skill	-	-	-	0.375 (4.300)
Accessibility to raw materials	-	-	0.640 (9.111)	-
Transportation cost (local)	-	0.283 (2.969)	-	-
Transportation cost (oversea)	-	-	0.182 (2.690)	-
Acquisition of technology (R&D)	-	0.281 (3.049)	-	-
Investment incentive	0.301 (3.038)	-	-	-
Tax holiday	-	-	-	0.162 (2.071)
Import and export exemption	-	0.226 (1.542)	-	-
Investment guarantee	-	-	-	-
politic instability and risk	-	-	-	-

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Inflation	-	-	-	-
Corporate tax	-	-	-	-
Exchange rate	-0.116 (-1.242)	-	-	-
Geographic closeness	-	-	0.077 (1.356)	-
culture closeness	-	-	-	-
Intellectual property right	-	-	0.091 (1.409)	-
Observation	128	128	128	128
Degrees of freedom	4	4	4	3
R-squared	0.625	0.585	0.631	0.621
Adjusted R-squared	0.600	0.562	0.619	0.605
F-statistic	51.920	51.256	52.494	51.569
(Constant)	(0.773)	(2.675)	(1.448)	(2.630)
Local market growth	-	-	-	0.219 (2.474)
Local market size	-	0.244 (2.847)	-	-
GSP/MFN	-	-	0.387 (4.660)	-
ASEAN market	0.154 (2.132)	-	-	-
Lower unit labor cost	-	-	-	-
Labor skill	-	-	-	-
Accessibility to raw materials	0.742 (11.247)	-	-	-
Transportation cost (oversea)	-	-	-	-
Acquisition of technology (R&D)	-	-	-	-
Investment incentive	-	-	-	-
Tax holiday	-	-	-	-
Import and export exemption	-	-	-	-
Investment guarantee	0.086 (1.339)	-	-	-
Trade barrier	-	-	-	0.170 (1.872)
politic instability and risk	-	-	-	0.137 (1.452)
Inflation	-	-	0. 240 (1.486)	-
Corporate tax	-	-	0.223 (1.384)	-
Exchange rate	-	-	-	-
Geographic closeness	-	0.297 (2.139)	-	-
Culture closeness	-	0.283 (2.038)	-	-

Intellectual property right	-	-	-	-
Observation	**128**	**128**	**128**	**128**
Degrees of freedom	**3**	**3**	**3**	**3**
R-squared	**0.601**	**0.594**	**0.580**	**0.593**
Adjusted R-squared	**0.591**	**0.572**	**0.561**	**0.571**
F-statistic	**62.163**	**52.305**	**51.098**	**52.245**
Transportation cost (oversea)	-	-	-	-

Note: The blank shown by (-) represent that the variables are eliminated from the statistical analysis because of insignificant results; Dependent Variable: Capital Register.

The t-values of lower unit labor cost is 1.790, which is at 5% significance level. While, the adjusted R^2 for the regression of lower unit labor cost = 0.600 is close to 1 and the 60.0% of the variation in the FDI in Cambodia and shows that a relationship between lower unit labor cost and FDI in Cambodia. Besides, the significance of lower unit labor cost is at $\rho = 0.076$, which is close to zero (See Appendix A). This result is explained by suggesting a positive relationship between the lower unit labor cost and the FDI in Cambodia.

The determinant of FDI result in this study is consistent with the study of Srinivasan and Mody (1998) on US and Japanese FDI for the period 1977 to 1992. So, the null hypothesis is rejected and support is found for the alternate hypothesis that there is a positive relationship between cost factors (lower unit labor cost) and the FDI in Cambodia.

Statistical Results of Model 2

As the regression results of the model 2 (Table 5.3) indicate, transportation acquisition of technology (R&D) is supported in terms of the relationship between cost factors and the FDI in Cambodia.

The size of coefficient of acquisition of technology (R&D) is 0.281, mean that if the acquisition of technology (R&D) increased by 1 %, the FDI is increased by 0.281%, while the sign of the acquisition of technology (R&D) is positive (+), indicating the positive acquisition of technology (R&D) effect.

The t-values of acquisition of technology (R&D) is 3.049, which is 5% significance level. While, the adjusted R^2 for the regression of acquisition of technology (R&D) = 0.562, which is close to 1 and the 56.2% of the variation in the FDI in Cambodia and shows that a strong relationship between acquisition of technology (R&D) and FDI in Cambodia. Besides, the significance of acquisition of technology (R&D) is at $\rho = 0.003$, which is close to zero, (See Appendix A). This result is explained by suggesting a positive relationship between acquisition of technology (R&D) and the FDI in Cambodia.

This result is consistent with the study of Papanatassiou and Pearce (1990) on host country characteristics and the sourcing behavior of UK manufacturing industry. So, the null hypothesis is rejected and support is found for the alternate hypothesis that there is a positive relationship between cost factors (acquisition of technology (R&D)) and the FDI in Cambodia.

Statistical Results of Model 4

As the regression results of the model 4 (Table 5.3) indicate, labor skill is strong supported in terms of the relationship between cost factors and the FDI in Cambodia.

The size of coefficient of labor skill is 0.375, means that if the labor skill increased by 1%, the FDI is increased by 0.375%, while the sign of the labor skill is positive (+), indicating the labor skill effect. The t-values of labor skill is 4.300, which is at 1% significance level. While, the adjusted R^2 for the regression of labor skill = 0.605 is close to 1 and the 60.5% of the variation in the FDI in Cambodia and shows that a strong positive relationship between labor skill and FDI in Cambodia. Furthermore, the significance of labor skill is at $\rho = 0.000$, which is zero (See Appendix A). This result is explained by suggesting a strong positive relationship between the labor skill and the FDI in Cambodia.

This result is consistent with the study of Taveira (1984) on foreign direct investment in Portugal; Schneider, Friedrich and Bruno S. Frey (1985) on economic and political determinants of foreign direct investment; and Teece (1986) on the multinational corporation and the resource cost of international technology transfer. So, the null hypothesis was rejected and support is found for the alternate hypothesis that there is relationship between investment climate factors (labor skill) and the FDI in Cambodia.

In conclusion, the results of Model 1, 2, and 4, show that cost factors (lower unit labor cost, labor skill, and acquisition of technology (R&D), have a relationship with the foreign direct investment in Cambodia, so cost factors represents as the determinants of FDI in Cambodia.

CONCLUSIONS AND RECOMMENDATIONS

Findings

Regarding to the performance of foreign direct investment in Cambodia, it can be concluded that most of companies, investing in Cambodia are small and medium enterprises. Furthermore, the performance of foreign direct investment in Cambodia in term of average sales growth from 2006 to 2007, indicate that most of companies are performed well in sale growth. This result shows that the investors have positive perception in doing business in Cambodia.

This study has demonstrated four main factors of the determinants of foreign direct investment in Cambodia in term of Capital Register. Each factor consists of the variables that can best explain the important level on the determinants of foreign direct investment in Cambodia. The main findings are indicated as following:

1. The lower labor cost in Cambodia is cheap and favorable enough to be the factors in attracting FDI if compare among ASEAN members. Because of most of multinational companies do consider much more about lower labor cost and they want to pay less for workers. Therefore, it can be concluded that lower labor cost is the factor attracting foreign direct investment into Cambodia.
2. The labor skill in Cambodia is not strong and favorable enough to be the factors in attracting FDI if compare among ASEAN members. However, the skill for some sectors would be considered strong enough as garment, textile, shoes and tourism sectors since Cambodia broadly opened her market. It can be interpreted that the foreign investors are interested with the labor skill of Cambodian people, because most of firms in Cambodia now are investing in the light industry which do need the high skill labor.

3. The acquisition of technology (R&D) in Cambodia is very weak to be the factors in attracting FDI into Cambodia, if compare with neighbored countries. However, the investors are interested in the technology which have been innovated by the firms since the country is still low in technology innovation.

Recommendations

1. RGC (Royal Government of Cambodia) should consolidate its efforts to retain GSP & MFN status by ensuring better working condition and follow the requirement of the owner. Cambodia should be closer with US, EU, Canada and other countries to lobby them to retain GSP & MFN for Cambodia.
2. RGC should try its best leverage all of GSP & MFN by not only export garments but also export other industry's products such as agriculture product, electronic product, equipment product and so on.
3. RGC should ensure the quality of student taking action to improve education system from kindergarten school to graduate school in order to upgrade the people skills, such as building capacity, transfer of know-how, technology, basic and professional training.
4. RGC should provide the student as well as entrepreneurship management information technology (MIS), such as internet, intranet, and so on. In this regard, RGC should establish more institutions of higher learning and professional skills such as Research and Development Institute and so on.

Future research

Although the number of possible extensions is almost overwhelming, a few appear to be particularly promising. The further study can incorporate these complex factors into the foreign direct investment allocation model. Finally, the scope of research could be expanded into macro level such as capital market and micro level such as expenditure on research and development (R&D) and training program. It will be interesting and useful for other researchers to conduct a study which includes whole country or specific location in Cambodia.

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APPENDIX A

Statistical Results of Hypotheses' Variables

Coefficients (a)

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistic	
	B	Std. Er	Beta		ρ	Tolerance	VIF
(Constant)	.242	.588		.411	.682		
local market growth	.226	.094	.217	2.415	.017	.780	1.282
lower unit labor cost	.242	.135	.177	1.790	.076	.648	1.544
investment incentive	.413	.136	.301	3.038	.003	.643	1.556
exchange rate	-.123	.099	-.116	-1.242	.216	.727	1.375

(a): Dependent Variable: Capital Register

Coefficients (a)

Model 2	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistic	
	B	Std. Er	Beta		ρ	Tolerance	VIF
(Constant)	.755	.516		.909	.365		
ASEAN market	.370	.125	.267	1.463	.126	.816	1.226
transportation cost (local)	.402	.135	.283	2.969	.076	.639	1.566
acquisition of technology **(R&D)**	.322	.105	.281	3.049	.003	.685	1.459
import and export exemption	.236	.132	.226	1.542	.096	.648	1.543

(a): Dependent Variable: Capital Register

Coefficients (a)

Model 4	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistic	
	B	Std. Er	Beta		ρ	Tolerance	VIF
(Constant)	-.152	.543		-.279	.781		
GSP/MFN	.190	.088	.184	2.153	.033	.747	1.340
labor skill	.504	.177	.375	4.300	.000	.721	1.386
tax holiday	.220	.106	.162	2.071	.040	.891	1.122

(a): Dependent Variable: Capital Register

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BARRIERS AND CHALINGES IN E-GOVERNMENT SERVICES: AN EMPIRICAL STUDY IN JORDAN

Mohammad Hjouj Btoush, Jawed Siddiqi

Informatics Research Group

Sheffield Hallam University, UK

mahjoujb@hera.shu.ac.uk

Raid Al-adaileh

Mutah University – Jordan

ABSTRACT

Although much progress in e-government services has been made in many countries, the evidence suggests a stark reality that much of e-government remains at an informational or early transactional stage. This is because delivering e-services poses complex challenges and requires a fundamental transformation or reinvention of both the structure and the functionality of any government. Therefore, it becomes inevitable to understand what hampers the realization of a full potential of e-services. In this paper, a review of the literature that analyses the barriers and challenges to e-service provision and development experienced in public sector organizations is presented. Subsequently, an identification of a framework that would be used in analysing the related research question is proposed next.

In order to validate the framework a survey was conducted of 484 participants, each of whom was involved in the provision of e-services, each participant was given a questionnaire that captured their perceptions of the barriers that hinder e-service development within the Jordanian context

Analysis of providers' perceptions involved first factor analysis used to assess the appropriateness of the questionnaire that was adopted from the Oxford Internet Institute, to determine the barriers that impede the development of e-services from providers' perception, further analysis involved computing of means of e-services barriers and their order and proportions according to their prevalence within the Jordanian public organizations.

The analysis reveals that the five barriers are: Policy, Economic, Skills, Technical, Organizational (PESTO); this confirms our proposed framework, which was used to provide a comprehensive discussion and interpretation of the results within a Jordanian context.

Keywords: E-government, e-services, Barriers & Challenges, Empirical study, Jordan, Developing countries.

INTRODUCTION

It is believed that technology alone will not warrant a successful implementation and diffusion of e-services [15]. Other factors underpin the accomplishment of having infused e-services in users' life. However, the promise of transformation traditional services into e-services is faced with a broad range of obstacles or barriers. Eynon & Dutton [19:229-30] define e-government services' barriers as:

> "*Characteristics—either real or perceived—of legal, social, technological or institutional contexts which work against developing networked governments because they: (a) impede demand, by acting as a disincentive or obstacle for users to engage with e-government services; or (b) impede supply, by acting as a disincentive or obstacle for public sector organizations to provide e-government services; or (c) constrain efforts to reconfigure access to information, people and public services in ways enabled by ICTs*".

The previous definition encompasses the different categories that form the barriers to effective implementation and adoption of e-services. It addresses the legal, social or cultural, technical and organizational constraints that could restrain the advocating of e-services. Furthermore, the definition takes into its consideration the obstacles that may face the stakeholders who attempt to use e-services. However, while this definition is a comprehensive and detailed one, it fails to address the financial barriers which are considered as major constraints to the implementation and adoption of e-services [15, 32].

Lau [33] defines the e-services barriers by dividing the barriers into '*external*' and '*internal*'. The external barriers include: legislative and regularity barriers, budgetary barriers, and the digital divide, while the internal barriers are closely linked to the organizational barriers; and involve lack of collaboration and coordination, officials' skills, public-private partnership, leadership, and monitoring and evaluation. However, although this clarification of the barriers helps to understand them better, there is a need to address the relationship between these barriers and the stakeholders involved in the provision.

The available literature on the e-services barriers tend to clarify the overall meaning of these barriers through an identification of the different categories that constitute what is known as barriers or challenges. The next section reviews the literature that discusses each barrier thoroughly. However, there is a paucity of work that provides empirical evidence connecting barriers to their providers; this is the hall work of this paper.

E-SERVICE BARRIERS

1. Economic Barriers

Financial barriers could hinder e-service progress on both supply and demand sides. Ebrahim & Irani [15] emphasise the importance of the financial barrier on both the providers' and users' sides. They contend that on the providers' side enough resources are needed to cover the cost of the adoption and the transformation of its services, while users are also very likely to be hindered by financial barriers when they, for example, become unable to afford using the internet to get the e-services. Edmiston [16:36] contends that the transformation of

traditional services to e-services is a magnitude transition, which requires immediate expenditure for very large fixed costs, he summarises the dilemma of the financial barrier within the public sector by stating that: "*the pain is immediate while the gain is distant*"; meaning that the need of huge funding to transform and develop traditional services into e-services would cause a financial burden on governments' budgets but it would reduce the operation costs eventually. Reinforcing this point, Heeks [22] argues that most of these costs are intangible, and that an awareness of their existence would lead to dealing with them sufficiently, or even reduce or eliminate their presence in the reality as barriers that might lead to partial or full failure of e-services' provision.

The costs discussed by Edmiston [16] and Heeks [22] reflect a broad area of costs associated with the e-services initiatives; and these include budgets to pay for the costs of hardware, software and public officials' trainings, ICT centers, network and other kinds of infrastructure. Norris et al. [38] consider that the problem with the public sector is that it is funded through the government budget, which might lead to a lack of financial resources from central government for e-services development. Lam [32] reinforces the previous point by arguing that the way of managing funds for e-services initiatives can be an obstacle, especially when funds are released in stages depending on the achievement of milestones in previous stages, so projects that do not take this into consideration are very likely to face financial shortage. Ebrahim & Irani [15] identify the main expected expenditure requirements that the governments face as '*operational costs*'; this includes: shortage in financial resources in public organizations, high cost of IT professionals and expertise, cost of installation, operation, and maintenance of e-government system, and cost of training and system development. Therefore, if costs are not met, they can seriously slow down the implementation of the e-government [56]. However, the difficulty to guarantee the flow pump of financial resources for developing e-services is due to the difficulty of a clear measurement of the benefits in investing in systems and equipments, especially when the benefits are of the long-term kind. Thus, they become difficult to define due to their intangibility or the fact that they are set in the future [41].

Moreover, the cost on the other side of the equation is by no means less important, for even if governments manage to overcome the high cost of implementing and providing e-services, they still need to ensure that their citizens can afford to get these e-services. This issue is more obvious in the developing countries where the low income is encountered by high IT cost of the Internet and the PCs. [1, 15]. A fact that would lead to a deprivation of the users' right to benefit from the available e-services due to their inability to afford buying PCs or paying for using the Internet networks. Therefore, the cost of implementing and using e-services might complicate the whole process of transformation of traditional services if not planned adequately.

2. Skill Barriers

Although many countries around the world have managed to transform many traditional services into online ones, the fact remains that more digital services does not necessarily mean more take up [44]. The skill barriers remains an important obstacle to the e-service acceptance and use. However, the skills barriers does sometimes have an interlocked relationship with the financial barriers. Ho [25] states that different socioeconomic

backgrounds influence the extent to which citizens use the Internet and computers. To illustrate this, we should realize that there are usually certain groups of societies that are described as "heavy users" of the traditional governmental services; those are people on low incomes, the elderly and people with disabilities. However, those groups do not usually have an access to the e-services due to the lack of financial resources and technical skills, which leads to what is known as the digital divide. A term that is defined as:

"*The gap between individuals, households, businesses, and geographic areas at different socio-economic levels with regard both to their opportunities to access Information and Communication Technologies (ICTs), and to their use of the internet for a variety of wide activities*" [39:1]

In brief, it is the gap between the "*technology haves*" and "*have-nots*" [49]. Lau [33] considers that the exclusion of certain groups due to the digital divide deprives them from getting any benefits of service quality enhancement and the availability of greater choices through online services. Furthermore, he argues that governments could provide services through other channels to their citizens, but the inability to provide online services to all could be a barrier that holds back e-services projects. Pieterson et al. [43] argue that although access to ICT is a basic requirement to engage with e-services, it is not the only thing; rather there is a need to have a motivation and skills to use ICT.

However, the lack of human infrastructure is also another obstacle in developing e-services; Chen & Gant [11] & Ho [25] consider the shortage of IT skills, for example, as a potential barrier that obstruct the governments' plans to deliver e-services. Echoing this point, Ebrahim & Irani [15] acknowledge that the lack of capable IT staff, effective IT training and support as major impediments that hinder to a great extent any real progress in the provision of e-services. They attribute this shortage to different reasons; such as, the improper technical training, the increased turnover rate of IT staff from public sector organizations to the private sector due to payment and work conditions.

3. Technical Barriers

Technical barriers can be major practical impediments to effective e-government systems [19]. A major technical barrier is the lack of architecture interoperability between the governmental agencies. According to [15, 19, 32] the inability to exchange and use information between different governmental agencies, when their services go online; is an impediment to the integration of the different services, this in turn limits the efficiency and effectiveness of the public services. A European Commission report [17:5] defines interoperability as "the ability to share information and technology through using common policies and standards." However, the lack of standardised way to connect data resources, information technology, and business process in the government agencies leads to what is known as "*islands of IT*" or "*Islands of Automation*" [32:519], or to what is described as public sector fragmentation which stands in the way of improving e-service quality through integration[15].

Another technical barrier is the inadequate technical design of the user interface [19, 55]. This barrier emphasises that if the e-service usability is inadequate- which means that it does

not provide information and content in a way that suites all, regardless of their abilities- the users' experience in using online services might become a source of frustration due to the experienced difficulty in access and use, leading eventually to the total abandonment of the e-services' usage. Moreover, the lack of technical infrastructure is another impediment. This includes the existence of a well-developed public key infrastructure and reliable Internet connections [55].

4. Policy Barriers

Any plan for electronic service adoption, employment, and development should include a suitable legal framework of appropriate laws, regulations and directives that facilitate the services' provision and use in a safe, secure electronic environment [20, 55].

The lack of such a frame work causes potential barriers at different levels. For instance, Vassilakis et al. [55] consider that the inadequate laws that cannot address effectively the proof-of-identity and the integrity of the documents online cause a serious hurdle in the way of developing e-services. Other issues in the electronic environment are also in need to be addressed clearly through a set of regulations that would make e-services development goes smoothly. Lau [33] and Vassilakis et al. [55] acknowledge the importance of secure identification, authentication systems, privacy and security applications to ensure handling sensitive transactions and personal information. The weakness in these areas is considered an impediment to gain users' trust to use e-services.

Ebrahim & Irani [15] point out that many users are actually not keen to use electronic services because of the lack of trust in this form of services; especially when it comes to revealing sensitive issues like personal information, and making financial transactions that are most likely to be shared between more than one government agency. Eynon & Dutton [19] confirm this by noting that while the use of the Internet and e-commerce in the private sector is gaining general trust among users, e- government services raise more trust concern. Accordingly, this can lead to 'trust tension' between governments' need to collect data on individuals to provide services, and users' fears of misusing their personal information. Therefore, the need to establish privacy and security polices from early stages becomes very important to avoid loosing users confidence in using e-services.

Moreover, different regulations between government agencies could hinder the progress of the e-government. This could be understood when multiple agencies with different legislations are involved in the provision of an e-service, which might delay or even prevent the e-service provision, adding to this, there is the liability issue of who holds responsibility if things go wrong due to technical failure, which is another legally unsolved issue. Liability risk can also arise when there is a breach of intellectual property, privacy or confidentiality rights [19, 33, 55].

5. Organizational Barriers

Public sector organizations represent mammoth bureaucratic units or what Lam [32] refers to as legacy of government processes and applications established over many years. The novel

presentation of electronic services to replace the traditional ones is likely to be resisted by the civil servants who might be sceptical about the effects that this change would bring. Fear of jobs' loss or privileges' diminishment is one of the administrative impediments to welcome the introduction of e-services in public sector [53]. Lam [32] calls the feelings of the employees when e-services are presented in their organizations as a "*cultural shock*" because there is not enough awareness of what the concept is about and employees find it hard sometimes to cope with the fast changes that take place in their organizations. Therefore, a strong government leadership and responsive management processes must support this transformation of traditional legacy of services [15]. Furthermore, the role of the leadership is crucial to develop and diffuse e-government vision, guide transformation, enhance co-ordination of initiatives, and provide incentives for agencies to join in [40].

Vissilakis, et al. [55] suggest another important impediment which is "*complex policies*", as government organizations' policies are oriented towards "*organizational comfort*" rather than "*citizen service*"; meaning that the lack of integration between the different government agencies forces the user to fill, for example, enormous documents for different organizations with the same information. Ebrahim & Irani [15] also refer to this as lack or poor communication and coordination between functional departments. Nevertheless, organizational barriers are major hindering factors in the adopting and diffusion of e-services. Plans and strategies should think beyond the mere presentation of technology in government organization, a need to change the management environment and the attitudes of the employees towards e-government initiatives, are among the ways to lessen organizational barriers [33, 55].

However, it is worth taking notice of the fact that the previous barriers tend to overlap; sometimes a barrier can lead to another one, for instance, the inability to afford e-services due to low income, which is a financial barrier, can lead to a digital divide which is seen as skills barriers. Moreover, sometimes the same barrier can be classified under two categories, for example, privacy and security can be related to skill barriers, technical barriers, or even policy barriers Nevertheless, all of them remain major barriers that do hinder the implementation and development of e-services.

E-SERVICES BARRIERS IN DEVELOPING COUNTRIES

Many researches and studies have addressed the barriers facing e-government implementation in developing countries. Barriers in these countries are highly correlated with the socioeconomic and political environment. The image about the developing countries is usually associated with poor economy, corruption, bureaucracy, illiteracy, etc. Obviously, all these are major factors in hindering e-service development.

Ndou [37] considers that the multidimensionality and complexity of e- services implies the existence of a wide variety of challenges and barriers to its implementation and management. The lack of proper ICT infrastructure, according to Nodu is a basic impediment; however, she argues that it is not only technology that matters but also the human who should have ICT literacy, education, freedom and desire to access the information and e-services. Echoing this,

Basu [6] asserts that development of e-government is associated with ICT infrastructure that is capable of supporting and enabling the execution of e-government. However, he argues that many developing countries do not have the infrastructure necessary to deploy e-government services.

Moreover, ICT infrastructure and its effect on e-services take up, is also addressed by Chen et al. [10]. They consider that the size and abilities of infrastructure between developed and developing countries differ dramatically. This in turn has its effects on the access to the Internet and the telephone for the dial up connections; so while almost all residents of developed countries have an easy access to the Internet and the telephone, the weak or deficient infrastructure in developing countries, which is a normal result of poor economic or political conditions, makes it hard to provide reliable access to all.

Another important barrier to a successful implementation of e-services in developing countries, which is cited a lot in literature, is an organizational barrier. Hierarchy is a traditional feature of public organizations in developing countries, the presentation of e-services initiatives in such organizations, means a sharing of information and knowledge that are most likely to be resisted by government officials. Nodu [37] argues that resistant to change by government officials is the biggest barrier to successful change within public organizations. However, Chen et al. [10] hold the view that government officials of developed countries are more familiar with IT, thus, they can realize its potential benefits in the public sector, while those of developing countries are usually unwilling to accept the change e-government brings, and they find it difficult to direct the already scarce resources to apply something they are not familiar with.

Moreover, the scarce resources to fund the costly e-government initiatives are another factor that hampers the e-services implementation and development in developing countries. Heeks [20] does not only describe this as a barrier, but actually ascribes failure to the whole e-government paradigm in developing countries. According to Heeks, a key issue that leads to that failure is the lack of awareness of the intangible costs which are to hamper the success of the e-government. Another financial difficulty in developing countries is the need to give a priority to more critical demands such as building roads and schools, especially when competing for scarce resources, rather than that of the IT investment or, more particularly, the transformation to e-services [1].

Acknowledging the financial barriers as an important impediment; Salem [47] argues that weak governance and a dominant role of the public sector in economic activity, the political conflicts that consume much of the public resources, which are mostly directed to military expenditure, the security threats of terrorism and war, as well as the politically motivated commercial or technological embargos all lead to high perceived investment risks, brain drain, outward capital movement and capital flight. Thus, accordingly it would become more difficult to provide successful e-services. Reinforcing this Chen et al., [10] argue that while many developed countries have stabilized economic and governmental systems, most developing countries either gain their independence relatively recently, or are still in a war

state; this is the case especially in the Middle East and Asia (e.g. Iraq, Afghanistan), which weaken the economic and government structure of these countries and those around them.

Saidi & Yared [45] also emphasise that the slow economic growth has caused slow rates of technological progress and innovation, which in turn cause a large digital divide in information and communication technologies. They further argue that while technologies have imposed extensive economic and financial linkages or integration in developed countries, developing countries in general have failed to respond to such a challenge. Salem [47] highlights an important obstacle that springs from the financial shortage of resources in developing countries, which have very limited resources to adopt e-services, therefore, they depend on loans from other developed countries which tend to dictate the best practices of deploying e-government services ignoring that these practices may not be suitable for developing countries' context.

Moreover, Basu [6] indicates the importance of the existence of a legal framework to guide the e-government legislative side in developing countries. New laws that deal with e-services must be adopted and passed. However, the lack of a socio technical vision is most associated with developing countries; since these countries often perceive e-services adoption as a technology mission which has contributed to unrealistic plans being deemed null and void [47].

From the review of the literature concerning the e-services barriers in both developed and developing countries, it seems that many barriers are shared. However, since this research is interested in exploring the stakeholders' perceptions of barriers, we consider moving from pure theoretical assumptions about the barriers in developing countries to a more explicit empirical investigation of what hinder the provision of e-services according to the providers themselves as an important step. Zhang et al. [57] argue that the evaluation of barriers according to the providers may vary because of the differing levels of participation in decision-making, changes that may occur to the providers' organizations and jobs, previous experiences working relationships with other participating organizations.

We take this argument as a departure point for this study, we argue that providers and users often exhibit different goals and concerns, and that providers tend to have more influence in deciding the direction and processes of the e-services' development because they are more involved in the decision-making processes, it becomes important to investigate their perceptions of the barriers facing them in providing citizen-centric e-services. Moreover, we propose a framework that encompasses these barriers, our framework resembles that of PEST analysis, which is simply a framework that categorizes environmental influences as: Political, Economic, Social and Technological forces that are likely to influence the supply and demand levels [28, 29]. Our framework has an additional factor that could highly influence the e-services adoption in the public sector, which is the organizational factor. Accordingly adding this factor creates PESTO that refers to: Policy, Economic, Skill, Technical and Organizational framework that would be used to address and analyse our proposed research aim that was developed from the previous discussions of barriers:

Determine and characterise the e-service barriers as perceived as by Jordanian e-service providers?

ANALYSIS OF PROVIDERS' PERCIPTION OF E-SERVICES BARRIERS

1. Factor Analysis

Factor analysis is a technique used to determine whether groups of indicators tend to cluster together to form distinct groups, referred to as factors, sometimes it is also used to establish whether the dimensions of a measure (a questionnaire) which are expected to exist can be confirmed [9]. In this research, factor analysis was employed for two purposes: Firstly, to manage in an effective and reliable way the relatively large set of data which is composed of 14520 pieces of data, which consists of 30 questions and 484 respondents. Secondly, to identify the barriers' dimensions that hinder the e-services development within the Jordanian context. The factor analysis camed out in the research involved four key stages: reliability test; principal component analysis; scree plot and factor rotation. The full details are provides in [24].

The use of factor analysis confirmed the existence of five barriers (Policy, Economic, Skills, Technical, and Organizational). However, to assess the reliability of this questionnaire, Cronbach's alpha test was used. According to this test, alpha (α) which indicates the reliability of this questionnaire = 0.86. This was considered as an acceptable level of internal reliability as the rule of thumb is that the result should be 0.80 or above [8]. To assess the internal reliability of the items that measure each dimension, the correlation between each item and the total score of its dimension was obtained through the examination of the component matrix using principle component analysis. All the 30 items were found to have higher loading than 0.20 which was considered as a salient loading that is also supported by the relatively large sample size (484 participants) used in this research [21].

The next step is to decide how many factors should be retained for the subsequent analysis. This was done through the use of the scree plot, which helps in providing a visual criterion which illustrates the extraction of five dimensions before the curve begins to flatten out. However, the choice of these factors is also based on previous theoretical knowledge, and on the assumption that with a sample of more than 200 participants (484 in this research) the scree plot provides a fairly reliable criterion for factor selection [50].The other technique that was used to determine the number of the factors that should be kept for the subsequent analysis is factor rotation, which clarified the factors or the five dimensions of the e-services barriers, and reduced any overlapping between them. It also increased the interpretability of these barriers. *Varimax* rotation method was used first. However, items or variables which correlate less than 0.3 with a factor are omitted from consideration [8]. *Varimax* rotation of the 30 items (questions) that constitute the questionnaire used in this research produced five factors of e-services barriers'. However, no significant differences were found when using (*Oblique*) or correlated factors method of rotation.

In summary the research was confirmed the existence of five different barriers to the implementation and the development of e-services. These barriers are: Policy barriers in which the concern is over legislations that do not infringe civil liberties. Economic barriers, these refer to the shortage of resources or funds for adopting, implementing, and developing e- services. Skills barriers, those are related to the lack of skilled staff and users. Technical barriers, these are mainly concerned with the unreliable IT infrastructure in public sector organizations. Finally, Organizational barriers which are related to the government's business process, management strategy, organizational culture etc.

2. Factor Analysis Outcome

The outcomes of this analysis confirm that five factors have been identified. They are Policy, Economic, Skills, Technical, and Organizational. For subsequent analysis, and in order to represent a composite of all items loading on each barrier, and to avoid the representation of a single item from each barrier, the mean of all items that measure each barrier were computed and used to examine the order and proportions of the identified e-services barriers. Since the number of the items that measure each barrier differ, the use of mean instead of the total score can eliminate any bias concerning the different number of items which represent each barrier.

To explore the relative importance of the aforementioned identified barriers, further analysis was performed; this included computing of the mean of the items that represent each barrier and comparing them together, since we were using a scale of 1-5; the normative mean would be 3.

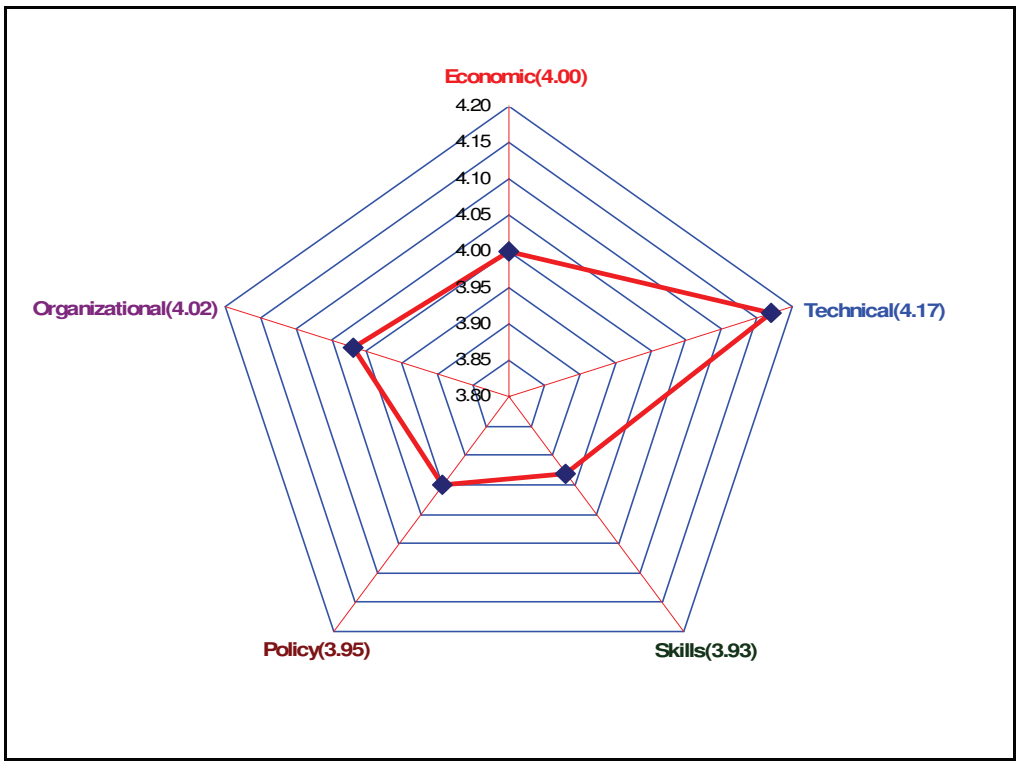
Table 1 shows the means of the identified e-services barriers. Clearly the table shows that all the barriers are closely grouped together around a mean of 4; there is not a significant difference between them.

E-Services Barriers	Mean
Technical Barriers	4.17
Organizational Barriers	4.02
Economic Barriers	4.00
Policy Barriers	3.95
Skills Barriers	3.93

Table 1: Means of E-Services Barriers

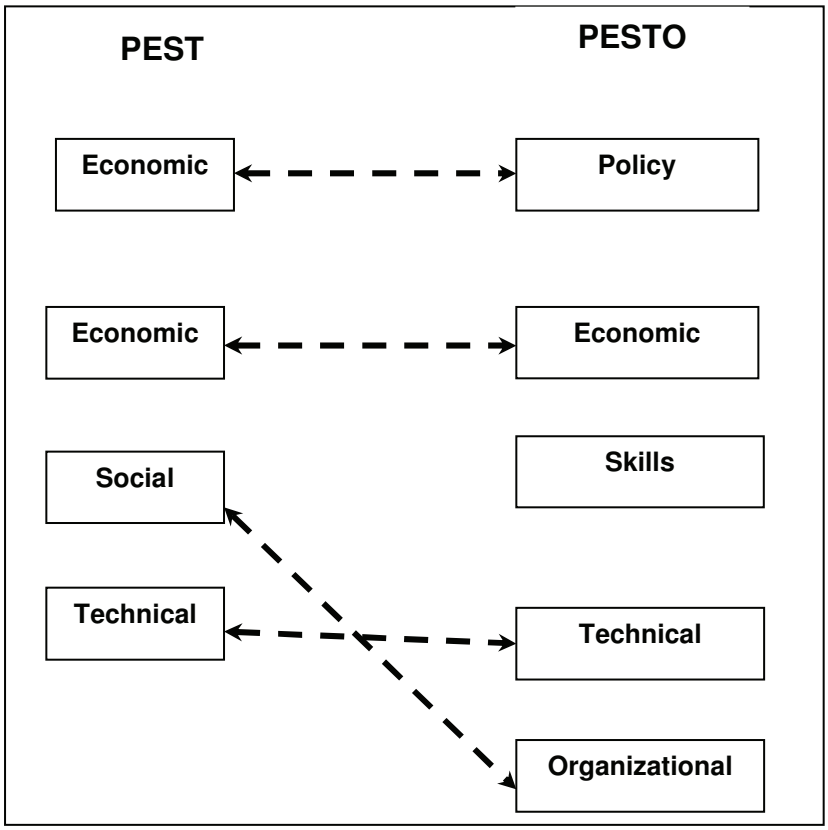
The Rader chart (figure 1) provides a pictorial display of the frequency distribution for the e-services' barriers, and illustrates the structure and the order of them within the research context. The results suggest that the Technical barriers are seen as the most important (4.17) though clearly both Organizational and Economic barriers were close: (4.02 & 4, 00) respectively, while Skills and Policy barriers came last with (3.93 & 3.95) respectively.

Figure 1: Radar Chart that shows the order of the e-services barriers in Jordan



Next, we present an explanation of these results within the framework that we suggested earlier to encompass all these different barriers: PESTO: that stands for Policy, Economic, Social, Technical, and Organizational. This framework resembles the PEST (Political, Economic, Social, and Technological) factors' analysis framework or tool, which was originally designed as a business environmental scan that helps to analyse the external macro environment in which business operates [28, 29]. In the same way, we consider it crucial to understand the factors that will probably affect the development of e-services. PESTO, which stands for similar factors that affect business, with the addition of skills, which is absent in PEST but is relevant to understand the barriers to e-services; because the level of expertise or skill stands clearly as a strong indicator of the quality of services, and as has been argued in the literature of e-services in developing countries skills barriers are one of the most significant barriers to e-services implementation and adoption [6, 13, 25, 37].

Figure 2: The proposed framework PESTO in comparison with PEST



3. Discussion of e-services barriers through PESTO

The above results identify the different e-services' barriers within the research context according to the perceptions of the providers of these e-services. The computing of the means of these barriers shows the perceived importance of each of the barriers within the research context. Employees of Jordanian Governmental Organizations (JGOs) have perceived the technical barriers to be marginally more important hurdle that impedes the e-services' development. Other barriers have also been seen as important as they hamper the e-services' progress to different degrees, the barriers that have been seen as the least in affecting e-services' progress are the skill barriers.

However, to understand the importance of the barriers to e-services' implementation and development within the Jordanian context, it is necessary to understand that these barriers are the outcome of different factors that affect the national strategy of e- government in general, and consequently the provision of e-services in particular. Following is a discussion of these barriers within PESTO framework.

3.1 Policy Barriers

Policy barriers were found to be significant within the Jordanian context. Policy can be defined as "a set of interventions from policymakers to policy implementers that spell out both goals and the means for achieving them" [36: 13] or "a set of ideas and the practical

search for institutional arrangements for their realization" [23: 3]. The lack of clear strategies that would guide the process of transformation from traditional regulations to electronic environment is an important impediment [48]. In the Jordanian context although the transformation of public services into e-services under the paradigm of e-government is supported by the political leadership of King Abdullah II, the government comes short of translating that support into tangible results. For example, the government has enacted the Electronic Transaction Temporary Law No. 85 of 2001 (ETL) in the year 2001 [2]. This law is applied to all electronic transactions, records, and signatures, where it is decided to adopt and use electronic means. However, this does not mean the exclusion of the application of traditional law. This is observed when many e-services that are related to the life cycle were excluded from this law by insisting that they must be conducted physically, for example, notifications regarding contract detachments of water, electricity and insurance, initiation and modification of a will, and notifications of decelerations, and procedures and pleadings and court judgments [4]. This in effect hinders the development of e-services that are citizen-centric. Therefore, more supportive acts, legislations, and regulations are still needed to facilitate change and help guide implementation of e-services in Jordan [5].

Moreover, within the Jordanian context the issue of privacy intersects with security issues so whereas Jordanians are worried over their right of privacy when conducting a public e-service, and how the government would use their private details, the government, on the other hand, is concerned that the unfettered access to public information and e-services would undermine national security and thereby social stability as Al-Omari [5] and Al-Ibraheem & Tahat [2] argue, that Jordan has missed great opportunity to effect the online activities by not incorporating protection instruments and principles regarding transparency, security, privacy, and protection of online activities. This lack of adequate online regulations of privacy and how it undermines users' trust of the e-services was emphasised by a senior employee who was interviewed and stated that:

"If we want to increase users' acceptance and utilization of e-services, we should address more adequately the privacy concerns; it is the only way to build users' confidence and trust in e-services."

3.2 Economic Barriers

In the Jordanian context, the economic barriers were found to be significant. This is highly justified in a country that has middle income and scarce natural sources [3]. The financial barriers to the development of e-service have received much attention in the literature, for example [15, 22, 28] all these studies, among others, have pointed out that the transformation of services to e-services through the adoption of e-government requires a huge budget to install, operate and maintain the systems, pay the IT consultant, and train the public personnel. However, this is usually faced with shortage of financial allocations in the public sector. In Jordan, this barrier becomes visible when we realize that Jordan is a country with very limited resources, 95% of its government budget comes from loans and grants [12].

However, the services sectors accounted for around 49% of GDP in 2003, with the IT sector contributing USD$295 million, or 2.9% of GDP according to INTAJ [26], this, however, has increased according to a recent report by The Jordan Times [52] which shows that the

Jordanian information and communication technology revenues accounted for 12 per cent of the gross domestic product (GDP). This could be due to the fact that the government, which is the principal domestic client, is implementing a number of e-initiatives. Yet, the virtually total dependence on external funds implies a great risk; for if the external funds decrease for one reason or another, the government will not be able to afford the expensive expenditures of the e-services' provision. This fact is highlighted by one respondent who states that:

"*Although there are scarce financial resources in Jordan, the government has allocated a huge budget for the e-services development, however, if the process of developing the e-services is not managed financially well, we are at the stake of losing the trust of our donors when they realize that all we do is in fact perpetuating the old practices of poor project management.*"

3.3 Skills Barriers

Although many initiatives have endeavored to make the Internet part of the Jordanian social and cultural life at a national level, skill barriers were found to be a significant barrier in the Jordanian context. Many initiatives that have been undertaken to tackle this problem, for example: PC@ every home, launched in 2004 aiming at raising Internet penetration by removing the barrier of possessing a PC barrier especially for the deprived areas. Another example is the Knowledge Station Initiative, launched in 2000 and its main purpose has been to enable segments of the Jordanian society, irrespective of their locations or economic status, to acquire the necessary new age ICT skills. Another initiative was directed towards the public sector employee is ICT Literacy Program, which provides the opportunity for the employees to be trained on worldwide proven and accredited standards in IT education, such as: ICDL, Cambridge training course, IT fundamentals, file management, word processing and computer networking and the Internet [32] Although the effects of such initiatives are to a certain extent tangible, the fact remains that a huge digital divide still exists within the Jordanian context; this digital divide can widen the skill barriers among the various stakeholders. One of its causes is due to the low level of the Internet penetration among the Jordanian citizens; this is because no policy has been in place to reduce the costs of broadband Internet access [12]. Actually Jordan's Internet prices are amongst the highest in the Arab region because the government imposes a sales tax of 16% on Internet, apart from the actual Internet prices that depends on the Internet speed [52]. In a nutshell; Internet in Jordan is available only to those who can afford it [30]. This fact becomes understandable if we take a look at the annual income in Jordan. According to the latest survey that was conducted by the Department of Statistics (Dos) between the years 2002 and 2006, the annual income per person, on average, is JD1, 082 [51], that is a GDP per capita of $ 2.850 which is relatively low [54]. Therefore, to a large proportion of the Jordanian society the Internet becomes unaffordable, which could unquestionably impede the use of the Internet and consequently the e-services. A respondent confirmed this conclusion by stating that:

"*The high prices of the internet are incompatible with the government tendency to create an e-society; if the prices will stay the same, we cannot expect the public to use the e-services effectively and constantly. The e-services use would not become part of our cultural practices.*"

Another cause for the digital divide is the lack of the necessary skills among certain groups of people, like the elderly, language–limited persons, less-well educated [7]. All these factors could also be applicable to the Jordanian context making the digital divide widespread and can seriously obstacle the utilisation of the e-services. Donini [14] argues that although Jordan endeavours to avoid a growth of a digital divide that rests on a social, cultural, or geographic basis, the self-evident fact that such a goal remains a simple declaration of intents, with no binding force. This might explain why the lack of skills is considered a barrier since socio-economic factors mean that a significant portions of the Jordanian citizens lack computer skills and will remain on the margins of e-services' use.

3.4 Technical Barriers

Technical barriers were found to be the most significant barriers to the development of e-services within the Jordanian context. Although Jordan has made promising steps in building IT infrastructure that would support its adoption of e-government and provision of e-services, such as the e-government models that were adopted by MoICT, which are well aligned with the current models of e-government in Western countries [12], there are, however, many challenges within the IT infrastructure [3] that would make it another barrier. These challenges are: the problems of incompatibility, implement solution, system interoperability and data exchange between the Jordanian Ministries and the government agencies that are attached to each ministry, so while ministries are using the latest state–of–the-art technologies, their related agencies are using refurbished PCs [12]. Another challenge is the lack of an adequate civilian telecommunications "backbone" network nationwide [5]. Moreover, the lack of IT experts is another related issue here. Ciborra & Navarra [5] argue that the lack of high qualified specialists in IT in the public sector means that the ultimate say on the design of the infrastructure would be that of the vendors, thus any breakdown is likely to seriously hinder the functioning of the broken e-service. In addition, any downgrading in the level of the security of the region may provoke the sudden evacuation of key experts and maintenance personnel, as it has recently happened with the Iraq war. Moreover, Al-Jaghoub & Westrup [3] point out that although Jordan invests heavily in ICT education and training to produce suitable workforce for an emerging ICT sector, this does not reflect much change because once people are trained and have gained experience, they are attracted outside Jordan where much higher wages are available.

3.5 Organizational Barriers

Organizational barriers were found to be very significant within the Jordanian context. Like most of the developing countries the public institutions in the research context are part of a larger chain of command and control in which there are levels of political decision making. Moreover, any national institutionalisation of e-government, and hence e-services usually includes the establishment of steering committees with the role of setting clear responsibilities and mandating for e-government development. However, e-services development in most Arab states has so far been largely project-based [46]. The lack of coordination and integration between the different agencies, and the existence of different visions and attitudes threat the very essence of the effective and efficient implementation of e-services. In Jordan, there are still limited efforts of public sector organizations reforms [5], a lack of proper institutional framework and operational leadership to drive e-services reduce

government capacity to effectively coordinate and implement e-initiatives according to Ciborra & Navarra [12]. Another important barrier that is related to organizations is the resistance from the employees. Resistance before and during the use of new IT systems is a major reason for e-initiative failure in organizations. Initial forms of apathy and passive resistance such as indifference, lack of interest, and complaints could develop into more hostile forms of resistance to change the legacy governments such as: active resistive behaviors to stop system use [15, 32, 42]. However, Jordan is not an exception, when it comes to the various forms of human and institutional resistance, it is like most of

the countries world wide where fear of job losses or anxieties about work and organizational restructuring could affect the employees' attitudes toward the implementation of the e-services, this in turn would result in diminishing the efforts to make e-services part of the organizational culture. According to the European Training Foundation [18], Jordanian people prefer working in the public sector for the benefits it offers, such as secure employment, favourable working hours, attractive retirements, social security benefits and high social statues. Therefore, it becomes expected that public sector employees will resist any change, and more specifically the transformation of traditional services to e-services in their organizations, because they fear that such a change will undermine their jobs' roles, or even cost them their jobs. Consequently, the organizational barrier becomes an important obstacle to the e-services' implementation and development.

CONCLUSION

For Jordan the political will of King Abdullah II is an important component in policy terms so that the enouncement of ETL 85 (2001) provides support for electronic transactions but in practice hinders the development of citizen centric e-services.

Similarly, absence of adequate privacy regulations does not engender trust in e-services. In financial terms, it appears that the management of financial resources is a significant barrier. Skills and Technical barriers appear to be highly inter-related in that the level of Internet penetration clearly impacts the skill level of the Jordanian citizens, it is further accentuated by the lack of ICT skills though clearly the various initiatives are attempting to bridge this gap in skills.

In line with other developing countries, and indeed, most of developing countries the organisational barriers identified in the PESTO analysis appear to be the same. Clearly, resistance by employees that ICT could impact their life is related to their understood anxieties over job loss. However, a further prevalent component in Jordan and other countries is the lack of an institutional framework, operational leadership to coordinate and implement e-service effectively.

In summary the research has reviewed literature on e-service barriers; it identified a framework incorporating five main impediments: Policy, Economic, Skills, Technical, and Organizational (PESTO). In contrast to most of the work in barriers to e-services this research empirically connects these barriers with the perceptions of providers to validate the proposed framework to the Jordanian context, which provides a rich interpretation and discussion of the results.

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THE SUCCESS FACTOR OF E-LEARNING: THE MEDIATE EFFECT OF THE E-LEARNER'S COMPETENCY ON LEARNING OUTCOMES

Dr. Li-An Ho, Tamkang University, Taiwan
lianho@mail.tku.edu.tw
Dr. Tsung-Hsien Kuo, Chinese Culture University, Taiwan
Testing Center at Securities & Futures Institute, Taiwan
love8671@gmail.com
Dr. Chien-Ting Lin, Chinese Culture University, Taiwan
ctlin@sce.pccu.edu.tw

ABSTRACT

The present study aims to (1) propose a conceptual structural equation model to investigate the relationships among e-Learning system quality (LSQ), e-learning readiness (LR), e-learners competency (LC) as well as learning outcomes (LO), and to demonstrate the direct and indirect effect of LSQ and LR on LO from the perspectives of LC. Data collected from 10 technological companies in Taiwan (N=379) were analyzed using structural equation modeling. Results reveal that both LSQ and LR have a direct and significant impact on LC. However, LSQ and LR influence LO indirectly through LC. In addition, LC has direct and positive significant influence on LO. Managerial implications are proposed and research limitations are discussed.

Keywords: e-learner competency, e-learning readiness, system quality, learning outcome

INTRODUCTION

The rapid advancement of Internet and computer technology has not only influenced the way we live, but the way we learn. As Frand (2000) points out that most young adult learners nowadays are more comfortable working on a keyboard than writing in a spiral notebook, and are happier reading from a computer screen than from paper in hands. According to Prensky (2001), student behaviors have changed during the past decade; thus, original educational system and learning planning have to change accordingly in order to receive expected effects. Many developed countries, such as England, Germany, United States and so on, have gradually integrated information technology into educational settings as well as corporate settings to support teaching and learning since 1980s (Starr & Milheim, 1996). In developing countries, such as Taiwan, e-learning has gained public awareness in recent years through its

popularity of educational resources for school teaching, learning and corporate training. According to Lee, Tseng, Liu and Liu (2007), e-learning can be used as a supplemental learning tool for supporting conventional teaching (e.g. face to face instruction), or as a stand-alone means for facilitating individualized learning (e.g. distance education). Both methods aim to improve learners' learning efficiency and effectiveness.

Past research indicates that the factors influencing the outcomes of e-learning include learner characteristics, such as proactive personality and learning goal orientation (Kickul & Kickul, 2006), learning strategy (Santhanam, Sasidharan, & Webster, 2008), learning motivation (Meissonier, Houzé, Benbya, & Belbaly, 2006), effective or appropriate e-learning environment (Gregg, 2007; Wangpipatwong & Papasratorn, 2007), technology acceptance, system quality (Chang & Tung, 2008) and so on. Within the field of learning behavior, there is many researches about learners' attitudes (Sun & Willson, 2008), instructional technologies (Wang, 2008), learning resources (Ouyang & Zhu, 2008), learning environments (Leung & Fung, 2005), learning methods (Wen & Stefanou, 2007), group collaborations (Webb, Nemer, & Ing, 2006) and so on. In addition, a number of studies have established a correlation between learning behaviors and learning outcomes (e.g. Koopmans, Doornbos, & van Eekelen, 2006; Könings, Brand-Gruwel, & van Merriënboer, 2005; Leung & Fung, 2005). However, beyond general assertions that the quality of the e-learning system, the e-learner's readiness and competency will lead to positive learning outcomes, existing literature offers no testable theoretical model to explain this connection. As discussed above, this study attempts to look at factors which result in positive learning outcomes through the proposal and empirical validation of a theoretical model. The model incorporates four major dimensions, namely: (1) e-learning system quality (LSQ), (2) the learner's e-learning readiness (LR), (3) the e-learner's competency (LC), and (4) learning outcomes (LO). A structural equation modeling approach is thus employed to test this model.

THEORETICAL FOUNDATION

E-learning System Quality

Innovations in educational technology have provided room for more online cooperative learning behaviors in the past decade (Duffy & Cunningham, 1996). According to Pollack (2007), distance education is using new technologies to increase learning and maximize collaboration between teachers and learners as well as among learners. In their study, Yli-Luoma and Naeve (2006) propose a semantic e-learning method based on four phases of knowledge conversion: socialization, externalization, combination and internalization. They suggest that different emotions and behaviors may be induced during various e-learning

phases. For example, the teacher-learner interaction in the socialization phase activates the exploratory learning behaviors. Existing body of literature presents a number of studies confirming certain attributes of e-learning system result in higher learning motivation or better learning behaviors, such as reading, searching, browsing, or collaborating and so on. (Jung, Herlocker, Webster, Mellinger, & Frumkin, 2008; Given, Ruecker, Simpson, Sadler, & Ruskin, 2007; Finder, Dent, & Lym, 2006). Thus, it can be argued that e-learning system quality plays a critical factor in learning behaviors and learners' achievements.

E-learning Readiness

Past researchers have investigated the use of technology in education as well as in corporate settings by analyzing the antecedents and outcomes of technology applications. For instance, Park and Wentling (2007) demonstrate that learners' computer attitudes influence their perceptions of the usability of the e-learning courses, and that such perceptions impact the degree of their skill developments, thus also the transfer of learning. Levin and Hansen (2008) argue that the learner's perceived values of utility determine the learner's attitudes toward course technologies, and that the learner's uses of course technology has a positive relationship with the learning outcomes. Additionally, in their study, Sivo, Pan, and Hahs-Vaughn (2007) find a strong and positive relationship among the students' attitudes towards Web-based instructions, end-of-course grades, online frequency, and the students' future preferences to take Web-based courses. Similar conclusions may also be identified in the work of Marcolin, Compeau, Munro, and Huff (2000), Agarwal and Prasad (1997), and Lin, Kuo, Kuo, Ho, and Kuo (2007). Existing literature presents a number of instruments measuring learners' readiness toward the use of technology in learning, such as Watkins (2005) and Parasuraman (2000).

E-learner Competency

According to Watkins and Corry (2004), the online classroom is a new learning environment that offers an array of obstacles and opportunities that learners must attend to in order to continue to their success. Watkins and Corry argue that success in e-learning requires the integration of new strategies for using online technologies effectively in conjunction with traditional learning skills. They conclude that two sets of essential proficiencies for e-learning success: (1) adapting old skills and habits from the traditional classroom for use in the online classroom, and (2) developing and applying new e-learning skills and habits for the online classroom. Mantyla (2000) claims that the 21st century learners play multiple active roles in learning and that 21st century trainers must verbalize the needs of the learners by providing: (1) information on how to apply the learning concepts to a job, (2) ways to effectively keep

up with changes, (3) proficiency in a job tasks and responsibilities time to learn, (4) support in the learning process, and (5) a motivational learning environment. Tan (2003) identifies four key elements of success of e-learners, namely time management, commitment and disciplines, motivation and pro-activeness, and positive attitudes. Sweeney (2001) suggests working adults who participate in e-learning to pay attention to the following issues in order to be successful e-learners. They are: (1) allocating quiet time, (2) discussing online leanrning schedule with their managers and/or co-workers, (3) be considerate of others, (4) setting realistic learning goals, (5) be active participants, (6) creating peer e-learning groups, (7) accommodating oneself, (8) reflecting on what they have learned, (9) using all available resources, and (10) sharing what they have learned.

Learning Outcomes

Past research indicates that certain online behaviors determine the outcomes of the student achievement (e.g. Hoskins & van Hooff, 2005). Specifically, Webber (2004) identifies a link between orientations to learning and various outcomes of learning activities. In addition, Könings et al. (2005) find that learners' perceptions of a learning environment influence their subsequent learning outcomes, which consequently affect the quality of their learning achievements. Whisler (2005) states that the online interaction, including instructor-to-learner, learner-to-learner, learner-to-content, and learner-to-learning interface, is a critical component of learner satisfaction. In fact, how learners learn to use technology (i.e. be familiarized with the learning environment) is also crucial to their learning outcomes. Lei (2004) compares learners' learning outcomes and perceived effectiveness with their e-learning behaviors as well as their computer attitudes, computer experiences, and demographic characteristics. The results show that lengthy computer experience does significantly affect learners' achievement scores. In addition, learners appear to benefit from frequent online interactions with peers, instructors, or content material. Furthermore, learners' self-regulatory behaviors as well as formative assessments with self-reflection are important aspects of 5th grade science learning (King, 2003).

METHOD

Research Structure and Hypotheses

The relevant hypotheses of the model and questionnaire design are presented below. The research model is shown in Figure 1.

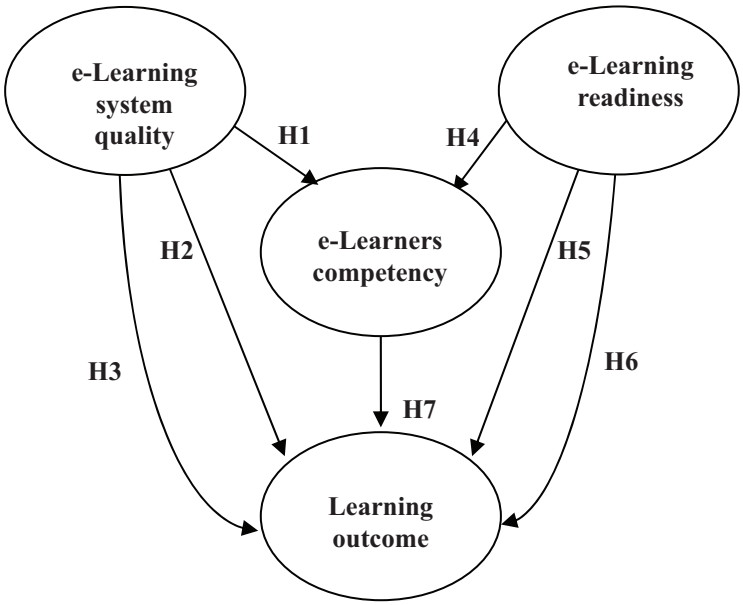

Figure 1. Research model for structural equation modeling analysis

H1: E-learning system quality positively influences the online competency of the adult learners.

H2: E-learning system quality positively influences the learning outcomes of the adult learners.

H3: The impact of the adult learners' online competency on learning outcomes is stronger under the influences of e-learning system quality.

H4: E-learning readiness positively influences the online competency of the adult learners.

H5: E-learning readiness positively influences the learning outcomes of the adult learners.

H6: The impact of the adult learners' online competency on learning outcomes is stronger under the influences of their e-learning readiness.

H7: The online competency of the adult learners positively influences their learning outcomes.

Questionnaire Design

The questionnaire is composed of five parts including: e-learning system quality, e-learning readiness, e-learner competency, learning outcomes and personal background (i.e. gender, age, and e-learning experience). The questions were answered using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Details of the dimensions are described as following.

E-learning System Quality

This study adopts the three-factor model of IT quality dimension proposed by Medina and Chaparro (2007). The model includes the three most studied elements in the modern world:

a. The information quality: refers to the appropriateness, update-ness, usefulness, accuracy, completeness, and relevance of the online course content.
b. The system quality: refers to the friendliness, flawlessness, efficiency, and adaptability of the e-learning system.
c. The service quality: refers to the tangible aspect of the system, which refers to staff reliability, responsibility, and empathy as well as the learners' confidence in online staff.

E-learning Readiness

This study adopts the readiness survey, which was validated by Watkins (2005) to assist potential e-learners in assessing their readiness of e-learning. The instrument includes:

a. Technology access: refers to access to hardware and software required for e-learning participation.
b. Online skills and relationships: refers to basic computer and internet skills in order to participate in e-learning, as well as to communicate with their peers and instructors.
c. Motivation: refers to the learners' psychological states, which may predict the retention, persistence and success of e-learners.
d. Online audio/video: refers to the capacity to learn while using e-learning technologies (for example two-way desktop video conferencing).
e. Internet discussions: refers to e-learners' skills in effectively communications with peer and instructions.
f. Importance to your success: refers to additional characteristics of e-learning courses and workplace contexts reviewed by the learners prior to committing to an e-learning.

E-learner Competency

This study adopts the e-learner competency model proposed by Birch (2001). The model consists of three factors:

a. Self-direction competency: refers to e-learners' ability in self-advocacy, self-sufficiency, self-confidence.
b. Meta-cognitive competency: refers to e-learners' higher-order thinking involving active control over the cognitive processes engaged in learning and self-evaluation process.
c. Collaborative competency: refers to the skills needed when participating in synchronous or asynchronous online learning activities, which includes chat sessions, email exchanges, discussion threads, instant message and virtual classrooms.

Learning Outcomes

This study adopts van Gelderen et al.'s (2005) three measures in assessing adult learners' outcomes of e-learning:

a. Goal achievement: refers to the extent to which the self-perceived learning results of the

e-learners are consistent with the expectations of the e-learners, and the instructors.

b. Satisfaction: refers to the extent to which the e-learners are satisfied with the e-learning system, their learning initiatives, as well as the strategies they take to learn or react online.
c. Skill development: refers to whether the knowledge and skills learned online can be transferred to handle job-related tasks or real-life situations.

Sampling

The data used in this research consists of questionnaire responses from participants in 10 technological companies at The Science Park, which located in Taipei city, Hsinchu city and Taichuang city in Taiwan. According to the size of individual science park, three companies were selected from Taipei Science Park, five from the Hsinchu Science Park, and two from Taichuang. The selection criteria include (1) the number of fulltime employees exceed 500, and (2) lengthy e-training experiences. One hundred questionnaires were circulated at the human resource management department in each company. Thus a total of a thousand survey questionnaires were distributed. Among which, 387 surveys were returned and 379 were valid for analysis (valid return rate is 37.9%). Non-response analysis is conducted to ensure the absence of non-response biases. The results show that there is no difference between respondents and non-respondents. Table 1 shows the sample characteristics.

Table 1. Sample characteristics

Construct	Classification	Number	Percentage (%)
Gender	**Male**	**210**	**55.4**
	Female	**169**	**44.6**
Age	**< 30**	**58**	**15.3**
	31 – 40	**156**	**41.2**
	41—50	**108**	**28.5**
	> 50	**57**	**15.0**
e-learning experience	**Yes**	**245**	**64.6**
	No	**134**	**35.4**

ANALYSIS AND RESULTS

Reliability and Validity Tests

Cronbach α reliability estimates were used to measure the internal consistency of these multivariate scales (Nunnally, 1978). In this study, the Cronbach α of each constructs was greater than 0.9251, which indicates a strong reliability for our survey instrument (Cuieford, 1965). Since the item-to-total correlations of each measures was at least 0.628, the criterion

validity of each scale in this study is considered to be satisfactory (Kerlinger, 1999). Table 2 shows the description statistics for each dimension. Both exploratory and confirmatory factor analyses were used to ensure that the instrument has reasonable construct validity. The result of both analysis is presented in Table 3. The confirmative factor analysis which consists of the convergent and discriminant validity was analyzed following Campbell and Fiske's (1959) criteria. Discriminant validity was examined by counting the number of times an item correlates higher with items from other factors than with items from its own factor (Aldawani & Palvai, 2002). Campbell and Fiske suggest that this number should be less than 50 percent. Results also show adequate discriminant validity. Jointly, the constructs in this study exhibit both convergent and discriminant validity.

Table 2. Survey structure and description statistics for dimension

Dimension	Number of items per dimension	Mean	Std. Dev.	Order	Cronbach's α
e-Learning system quality	12	3.5314	0.3844	2	0.9319
E-learning readiness	27	3.4925	0.5243	4	0.9565
e-Learner competency	11	3.5167	0.3651	3	0.9227
Learning outcomes	13	3.5675	0.3700	1	0.9251

Table 3. Factor analysis and internal consistency values for the questionnaire

Dimension	Factor	% of Variance	Cumulative %	Item-to-Total Correlations	Cronbach's α
e-Learning system quality	Information quality	27.672	78.364	0.6861	0.7326
	System quality	25.483		0.6674	0.7582
	Services quality	25.210		0.6673	0.7557
E-learning readiness	Motivation	14.530	74.340	0.7300	0.8634
	Internet discussions	14.221		0.6936	0.8693
	Online skills and relationships	14.022		0.7038	0.8682
	Importance to your success	12.408		0.6820	0.8711
	Technology access	10.791		0.7298	0.8634
	Online audio/video	8.369		0.6825	0.8717
e-Learner competency	Self-direction competency	29.641	76.464	0.6788	0.7609
	Meta-cognitive competency	24.988		0.7022	0.7371
	Collaborative competency	21.835		0.6624	0.7771
Learning outcomes	Skill development	24.786	72.521	0.6887	0.7248
	Goal achievement	23.916		0.6535	0.7614
	Satisfaction	23.819		0.6597	0.7531

Analysis of the Structural Equation Model

The structural equation modeling approach is a multivariate statistical technique for testing structural theory (Tan, 2001). This approach incorporates both observed and latent variables. The analysis for the present study was conducted using LISREL 8.52 and utilizing the maximum likelihood method. In the proposed model (Figure 1), LSQ and LR are considered exogenous variables, and LO is considered an endogenous variable. LC serves as both an endogenous variable (to LSQ and LR) and exogenous variable (to LO). The individual questionnaire items were aggregated into specific factor groups. The following four rules were utilized for the hypotheses' structure: (1) each observed variable has a nonzero loading on the latent factor within the structure, but have a loading of zero towards other latent factors, (2) no relationship among measurement errors for observed variables, (3) no relationship among the residuals of latent factors, and (4) no relationship among residuals and measurement errors. The reliability results are illustrated in Table 4.

Table 4. Observed indicator reliability of factors

Dimensions	Factors	Observed indicator reliability
e-Learning system quality	Information quality	0.63
	System quality	0.60
	Services quality	0.58
E-learning readiness	Motivation	0.63
	Internet discussions	0.56
	Online skills and relationships	0.57
	Importance to your success	0.53
	Technology access	0.61
	Online audio/video	0.52
e-Learner competency	Self-direction competency	0.61
	Meta-cognitive competency	0.67
	Collaborative competency	0.56
Learning outcomes	Skill development	0.60
	Goal achievement	0.63
	Satisfaction	0.56

Additionally, the analytical results of the LISREL model reveal a satisfactory fit for our sample data. The final result of LISREL analysis is shown in Figure 2.

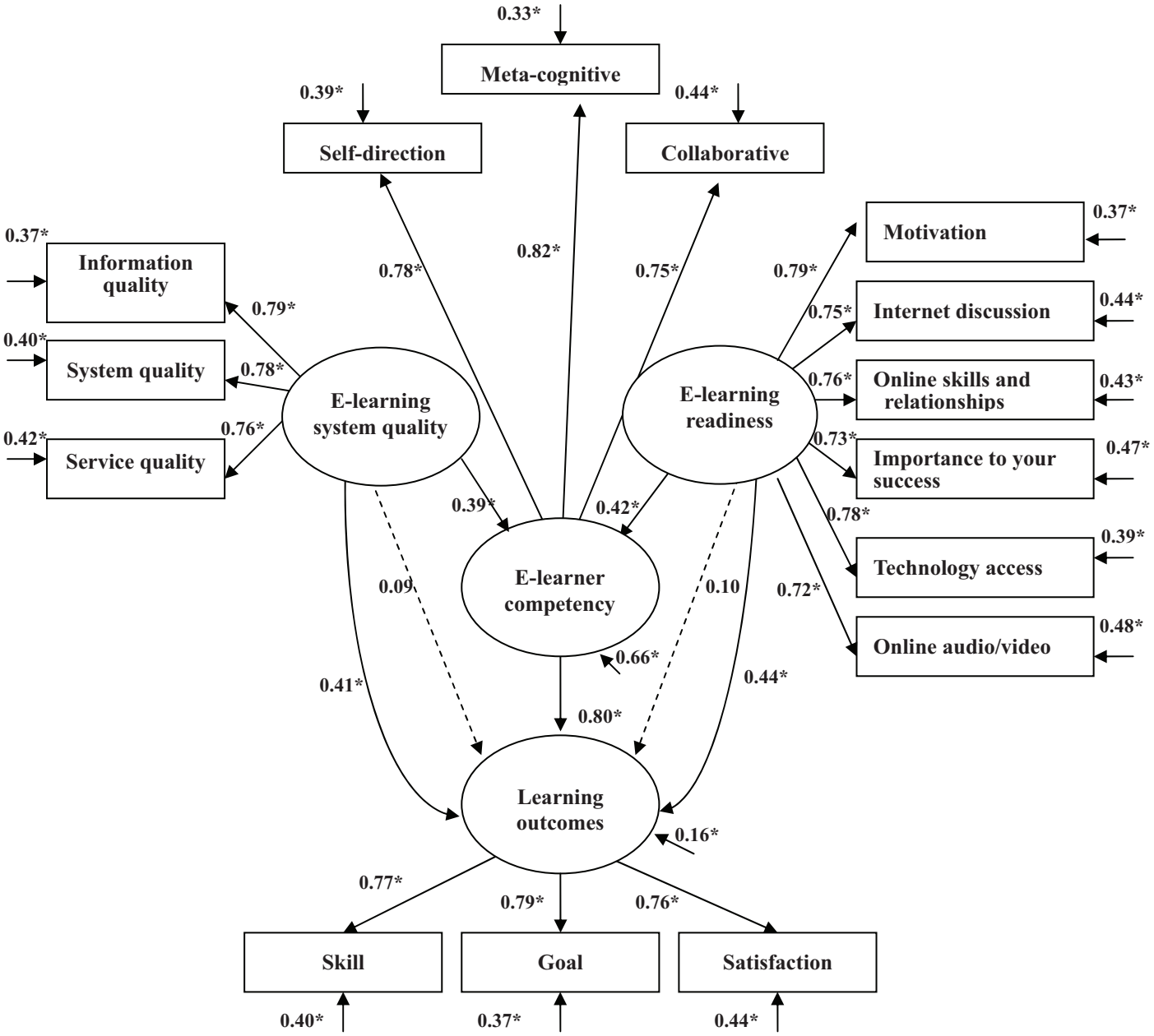

Figure 2. Research model for structural equation modeling analysis

The final SEM model analysis is presented in Figure 2. The absolute fit measures (GFI=0.95 AGFI=0.93 and RMSEA=0.0.046) indicate that the structural model either meets or exceeds recommended levels, and thus represents a satisfactory fit for the sample data collected. The Chi-square statistic divided by the degrees of freedom also indicates a reasonable fit at 1.81. It can be concluded that the proposed model maintains good construct validity (see Table 5 for the statistics of the fit test of the model). Based on Figure 2, five out of seven hypothesized relationships (H1, H3, H4, H6, & H7) show statistical significance.

Table 5. Fit test of the model

Measures	Indicators
Absolute Fit Measures	**Chi-Square with 84 Degrees of Freedom = 151.78 (P= 0.00)** **Goodness of Fit Index (GFI) = 0.95** **Root Mean Square Error of Approximation (RMSEA) = 0.046** **P-Value for Test of Close Fit (RMSEA < 0.05) = 0.69** **Expected Cross-Validation Index (ECVI) = 0.59** **90 Percent Confidence Interval for ECVI =(0.51 ; 0.69)** **ECVI for Saturated Model = 0.63** **ECVI for Independence Model = 17.60** **Adjusted Goodness of Fit Index (AGFI) = 0.93**
Incremental Fit Measures	**Normed Fit Index (NFI) = 0.98** **Non-Normed Fit Index (NNFI) = 0.99** **Comparative Fit Index (CFI) = 0.99** **Incremental Fit Index (IFI) = 0.99** **Relative Fit Index (RFI) = 0.97**
Parsimonious Fit Measures	**Parsimony Normed Fit Index (PNFI) = 0.78** **Parsimony Goodness of Fit Index (PGFI) = 0.66** **Critical N (CN) = 281.05** **Normed chi-square 151.78/84 = 1.81**

CONCLUSION

This study has focused on the discussion and analysis of e-learning system quality, e-learning readiness, e-learner competency, and learning outcomes of adult learners at 10 technological companies in Taiwan. Specifically, the study was designed to determine the effect of the learners' e-learning readiness and self-perceived e-learning system quality on the perception of their online learning competency. In turn, the effects of the adult learners' online competency on their learning outcomes were also examined. An empirical investigation using structural equation modeling shows that both the learners' perceived quality of e-learning system and their e-learning readiness are positive and important aspects in accommodating better goal achievement and skill development as well as higher learning satisfaction. However, it must be highlighted that the self-perceived system quality and e-learning readiness do not directly result in better learning outcomes. Rather, these factors serve as catalysts to stimulate or influence the e-learners' online learning competency (Hung & Cho, 2008). Appropriate e-learner competency, in turn, serves as the channels for better outcomes of learning. Therefore, e-learning system quality and adult learners' e-learning readiness can thus be seen as a part of a larger chain, where e-learner competency form the middle ring which links those factors with learning outcomes of e-learners (Lu & Yeh, 2008; Kaya, 2007; Siemsen, 1993).

While the empirical data collected have largely supported the proposed model, it is necessary to point out the limitations of this research. Even though the responding individuals consisted of well-informed and active e-learning learners of the participating technological companies,

the existence of possible biases or personal differences for e-learning cannot be discounted (e.g., different learning styles, the speed of learning of the participants and so on). Furthermore, it is evident that the platforms, content, and hardware equipment used can differ among these companies in different areas (e.g. suburban areas), countries, or even those in the same urban area universities offering dissimilar e-learning models (e.g. Dahl & Vossen, 2008; Lu & Yeh, 2008; Hu, Chen, Zeng, Hao, Min, & Liu, 2008). Therefore, the current data collected from the particular organizations in Taiwan may not be fully representative of other scenarios.

In conclusion, the study can suggest that managers of technological companies can improve their employees' learning outcomes in an e-learning environment by fostering proper online learning competency, such as promoting better self-directed learning habits, meta-cognitive skills, and online collaborative behaviors to accommodate the needs of the adult learners' with different levels of e-learning readiness. Training managers of technological companies can also provide well-designed e-learning systems that match the content of learning subjects and fit the preferences of the learners. Furthermore, managers and trainers are reminded that e-learning systems quality and adult learners' learning readiness are supported by appropriate leadership behaviors, without which better learning outcomes cannot occur.

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DEVELOPMENT OF A PROJECT-BASED COOPERATIVE LEARNING ENVIRONMENT FOR COMPUTER PROGRAMMING COURSES

Miss. Hui-Chun Chu, National University of Tainan, Taiwan
carolchu@mail.nutn.edu.tw
Dr. Gwo-Jen Hwang*, National University of Tainan, Taiwan
gjhwang@mail.nutn.edu.tw
Dr. Gwo- Haur Hwang, Information Management Department, Ling Tung University, Taiwan
ghhwang@mail.ltc.edu.tw

ABSTRACT

Project-based learning has been widely adopted in computer courses, especially for those subjects that aim to train students to developing systems cooperatively. Although several existing online systems have provided discussion forums or chatting rooms, more functions need to be provided for conducting project-based cooperative learning activities, such project management, cooperative learning group management, assistance seeking and group working area. To cope with these problems, a cooperative learning system is proposed in this paper to assist teachers in conducting project-based cooperative learning activities on the Internet. In this system, various facilities are provided to enable cooperative learning group management for teachers and project development for students. To evaluate the usefulness of the system, an experiment has been conducted on a computer course. From the experimental results, it is found that the system can fulfill the need of the students and the teachers, and is helpful in enhancing the learning efficacy of the students.

Keywords: Project-based learning, Cooperative learning, Computer courses, Computer-assisted learning

*Corresponding author: Gwo-Jen Hwang, e-mail: gjhwang@mail.nutn.edu.tw; TEL: 886-915396558; Fax: 886-3017001

BACKRROUND AND MOTIVATIONS

Owing to the popularity of computer and network technologies, the training of computer programming skill has become an important issue today (Bishop-Clark, 1988; Mayer, 1992; Kalles, 2008; Kordaki, Miatidis, & Kapsampelis, 2008). The objective of computer programming courses is to enable students to solve problems based on their understandings of syntax and structure of the programming language as well as the skills of programming. Researchers indicated that, the process of programming can be thought as the process of problem solving; that is, the ultimate goal of programming language courses is to teach the students to learn to solve problems with program design. Unfortunately, past research also found that, conventional tutoring strategies for programming language courses seemed to be of little help in training the general problem-solving ability of students. Researchers indicate that, current programming language tutoring has encountered several problems:

(1) Lack of the opportunities for peer interactions and cooperation.
(2) Lack of interactive operations with related examples while teaching or discussing

about programming knowledge.

(3) No instant feedback while students encountered problems in programming (Tseng & Hwang, 2007; Hwang, Tseng & Hwang, 2008).

(4) Lack of a project-based cooperative learning platform for programming language learning: most of the students are not well trained to use programming languages to solve problems.

As programming language learning is highly relevant to problem-solving ability, most researchers recommended the use of project-based learning strategy to improve the problems-solving ability of students in teaching programming language courses (Blumenfeld et al., 1991; Moursund, 1999; Trotman & Handley, 2008). Project-based learning is a student-centered learning strategy which provides a scenario to guide students to learn toward a predefined goal, such that the learning motivations and the problem-solving ability of the students can be promoted. Researchers indicated that, project-based learning is helpful to students in developing abilities in many aspects, improving the study skills, enhancing responsibility and participation, learning computer techniques, conducting self-assessment and peer-assessment, building portfolios, learning to control the work schedule and being aware of society consciousness (Blumenfeld et al., 1991; Moursund, 1999).

Encouraging learners to share learning resources or knowledge with others has been recognized to be an important objective of group learning (i.e., cooperative learning and collaborative learning), in which the group members are expected to help their group members achieve the shared goals of learning, thereby exerting maximum efforts to each other (Slavin, 1996; Stahl, Koschmann, & Suthers, 2006). In a cooperative learning activity, group members split the work, solve sub-tasks individually and then assemble the partial results into the final output (Dillenbourg, 1999); while a collaborative learning activity is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem (Roschelle & Teasley, 1995; Gillet et al., 2005).

Although several learning systems provide discussion facilities that can be employed to support group learning activities, such learning environments encounter a critical problem in practical applications, that is, the lack of group management functions for teachers and project development functions for students. As a consequence, in this study, we attempt develop the a project-based cooperative learning platform for programming language learning, which provides project development mechanisms for students and cooperative learning group management mechanisms for teachers.

DEVELOPMENT OF THE WEB 2.0-BASED LEARNING ENVIRONMENT

According to the design of the system functions, a cooperative learning system has been developed. To facilitate group learning activities, the learning system is designed as a teacher-oriented Blog that provides a discussion forum for the students in each cooperative learning group.

Functions for Teachers

In addition to the ordinary blog functions, several additional functions are provided to

assist teachers in designing learning activities and managing students' learning portfolios in this innovative learning environment. Some additional functions are described as follows:

- Learning group management: To assist teachers for efficiently creating learning groups and corresponding discussion areas, a management function is provided. In addition, this function enables teachers to compose cooperative learning groups in a manual or an automatic manner, as shown in Figure 1. In the automatic mode, the teacher can specify multiple criteria to be taken into account, such as the number of students and the average score of the pre-test in each group (Hwang, et al., 2008).
- Phase management: This function allows the teacher to segment the project into several phases.
- Discussion area management: This function enables teachers to manage the discussion area for each individual cooperative learning group, as shown as Figure 2.
- Questionnaire management: This function allows the teacher to enforce the students to answer some questionnaires before proceeding to the next phase of the projects.

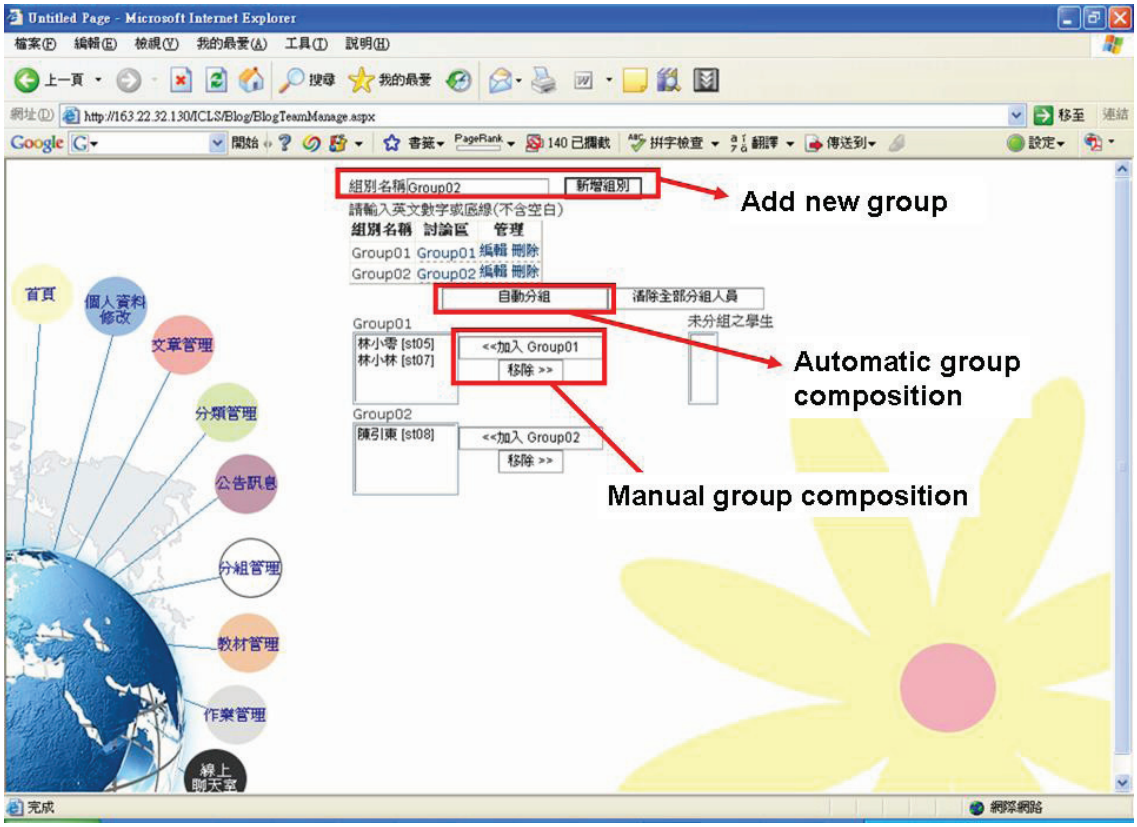

Figure 1. Illustrative example of the learning group management function

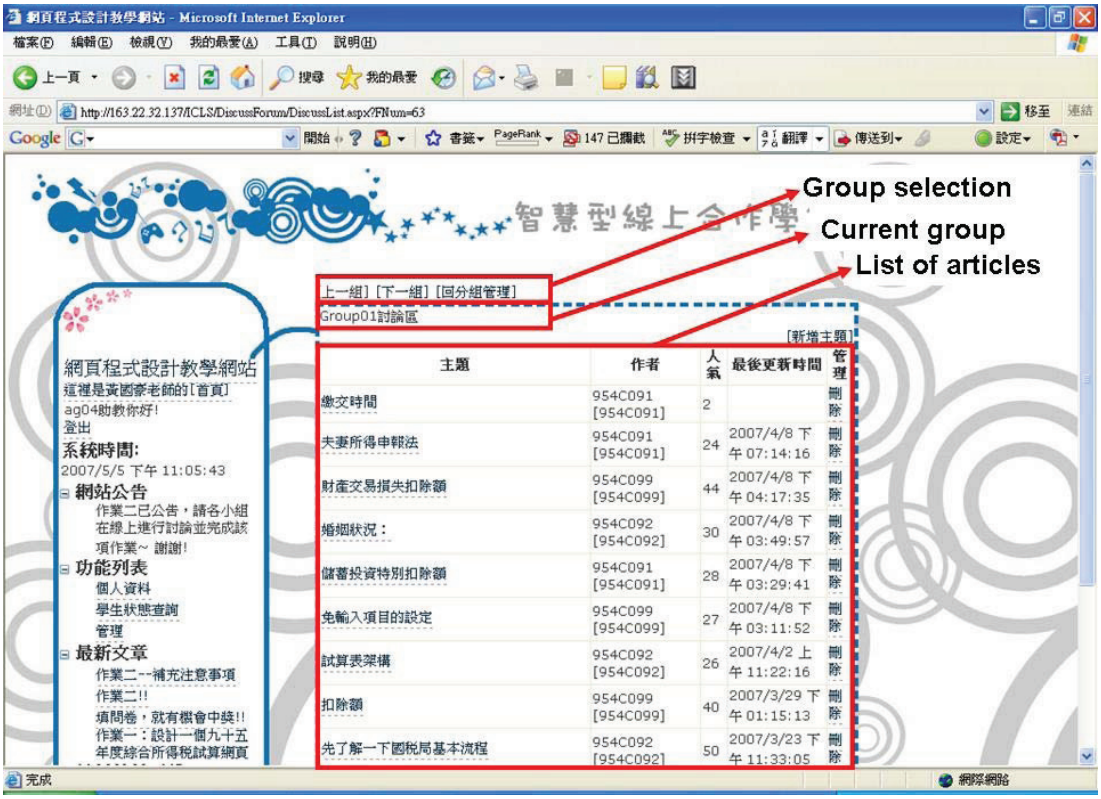

Figure 2. Illustrative example of the interface for group discussion management

Student interface and operating procedure

In addition to the ordinary Blog functions, students can discuss with classmates or group members about their homework in the group chat room or the group discussion area. Moreover, a group working area is provided for each group of students, in which the students can share and exchange any information or resource as well as publish their work, as shown in Figure 3. Moreover, a project management mechanism is provided to assist the group members in managing different versions of the tasks in the project.

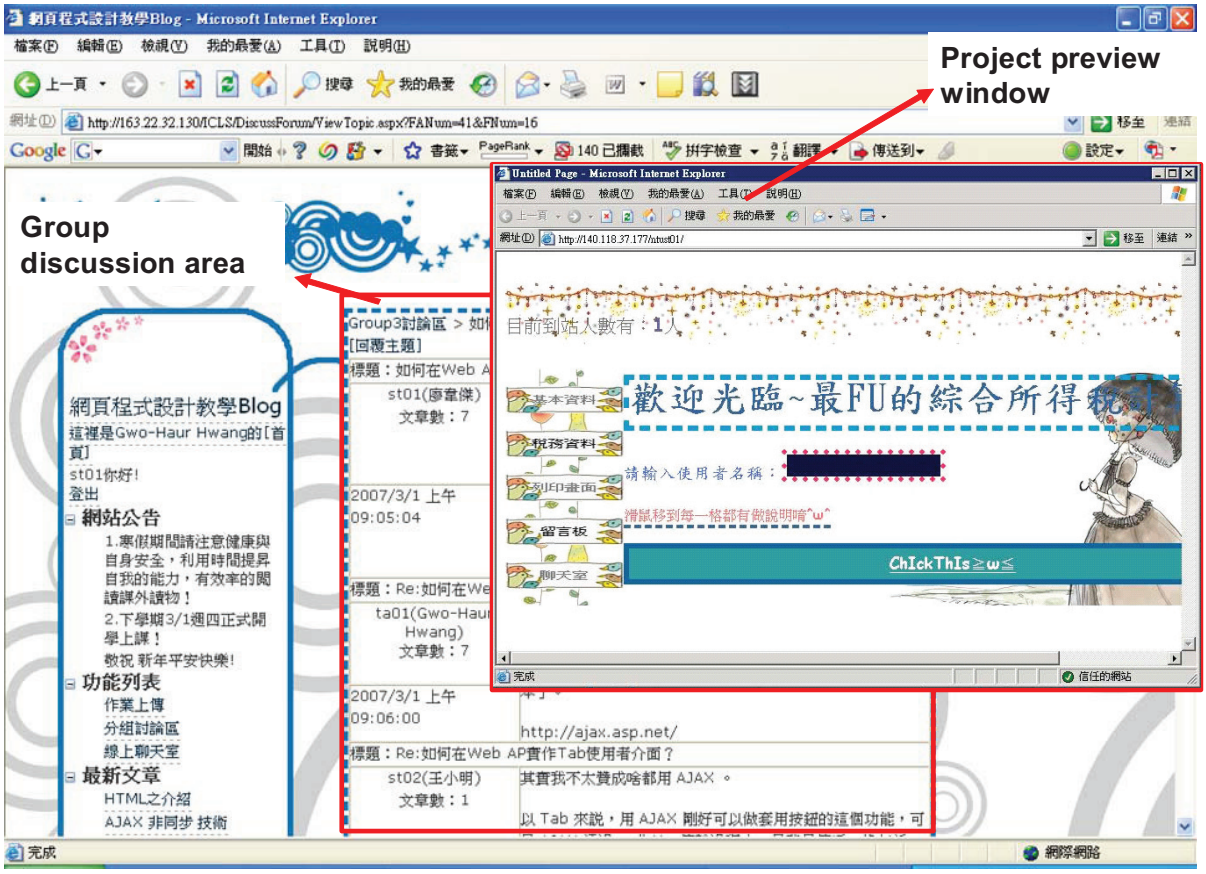

Figure 3. Interface of the group working area

In addition, a call-for-help function is provided to encourage students to send requests to anyone who is able to help solving problems encountered in doing team project, as shown in Figure 4. After receiving a request from a student, the system will forward the question to all of the classmates of that student, or the learners who have taken the same course, as shown in Figure 5.

Figure 4. Illustrative example of the call-for-help function

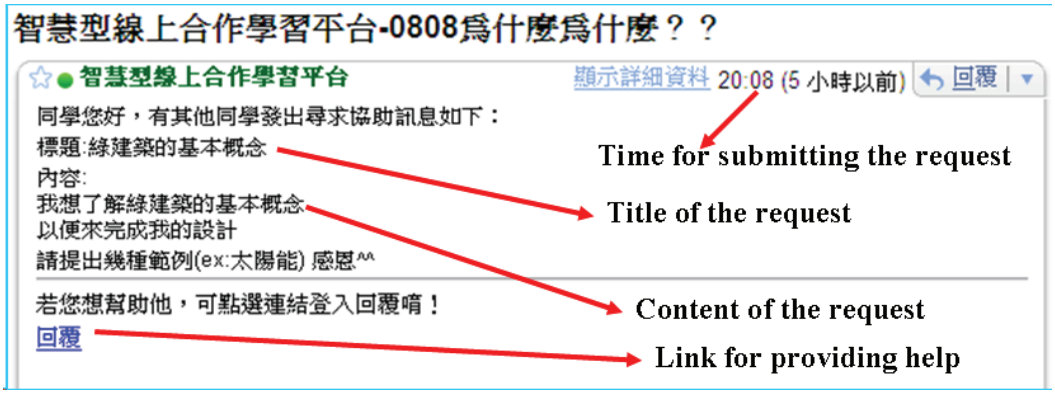

Figure 5. Interface for notifying the potential helpers

EXPERIMENT AND ANALYSIS

To evaluate the effectiveness of this system, an experiment was conducted on a course of an undergraduate program to collect data from the students. The system was applied to a web-programming course. One hundred and nineteen students were randomly assigned to forty cooperative learning groups.

During the five-week learning activity, the students were assigned to design the content of a tax website. In the first week, the teacher introduced the intelligent Blog and announced the account and the group number of each student. At the beginning of the second week, the teacher announced the group assignment, which needed to be done cooperatively via the synchronous and asynchronous discussion forums.

A questionnaire is used to evaluate the usefulness of the learning system for the students who experienced the system facilities. The rating mechanism is an integer ranging from 1 to 7, where '1' means the students strongly disagree with the questionnaire item and '7' means the students strongly agree with the questionnaire item. Table 1 shows the statistical results of the feedbacks from the students in the experimental groups. Nearly 80% of the students indicated that the group members have fully engaged in the project and have frequently interacted with each other (those with response above 5 in the Likert scale). About 70% of the students felt that the system was easy to use. In comparisons with other communication systems, nearly 70% of the students felt more willing to cooperate with their group members via this system.

Table 1. Feedbacks of the students in the experimental cooperative learning groups

Item \ Response	1	2	3	4	5	6	7
Our group members have fully engaged in the project by the learning system.	3%	1%	3%	15%	21%	26%	31%
There have been frequent interactions among our team members by the learning system.	2%	0%	2%	10%	16%	26%	45%
The learning system is easy to use.	6%	3%	4%	16%	25%	26%	20%
In comparison with other communication systems, I feel more willing to discuss with our group members via this system.	4%	1%	4%	22%	25%	23%	21%

CONCLUSIONS

Group learning has been recognized to be an important educational issue in recent years (Hwang, et al., 2008; Stahl, et al., 2006; Zurita & Nussbaum, 2004). It is implemented for a specific educational objective through a coordinated and shared activity by means of social interactions among the group members (Zurita & Nussbaum). These social interactions are essential elements to achieve the desired learning (Roschelle & Teasley, 1995).

Computer-supported collaborative/cooperative learning agenda aims to equip the socially interactive abilities and group problem-solving skills for students by using technology to mediate and encourage social acts that constitute group learning and lead to individual learning (Stahl et al.).

In this paper, a cooperative learning system is proposed to assist teachers in conducting project-based cooperative learning activities on the Internet. Various facilities are provided to enable cooperative learning group management for teachers and project development for students. An experiment has been conducted on a computer course to evaluate the usefulness of the cooperative learning system. From the feedbacks of the students who have experienced the cooperative learning facilities provided by the system, it is conclude that the innovative approach is helpful to the students in improving their cooperation.

In the near future, several relevant studies are going to be proceeded, including the development of a mobile version of the blog to assist the students to learn in an authentic learning environment (Chu et al., 2008). In addition, various group learning activities for different courses will be designed and conducted by applying the innovative approach.

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E-LEARNING IN SLOVENIA

Dr. Štefan Bojnec, University of Primorska, Slovenia
stefan.bojnec@fm-kp.si
Dr. Ajda Fošner, University of Primorska, Slovenia
ajda.fosner@fm-kp.si

ABSTRACT

This article presents the advantages and potential drawbacks of the integration of e-learning into the study process at higher education institutions in Slovenia in comparison with European countries. We have found that the Slovenian information society is at the comparable European level. The differences in the Internet intensity use are by the age, where Slovenia is lacking behing the most developed European countries for elderly people. The importance of the e-learning has been increased during the last decade. Currently more than 41% of enterprises are using e-learning applications for training and education of employees. Finally, there are more than 33% of the Internet users to gain new knowledge and information and 3% of persons that undertake different trainings through the Internet.

Keywords: information society, e-learning, education, Slovenia, European Union

INTRODUCTION

During the last decade the use of the information and communication technology, especialy the Internet, has increased rapidly. In the developed countries this process has been driven by the availability of technology at lower prices and supply of new oportunities to use these technologies for different purposes, including in education. The most advanced enterprises implemented this widely for tranings of their employees and also supply of different education courses (Fošner and Kramberger 2007, Sulčič 2008). Among the pioners in the e-learning are multinational companies such as IBM.

The aim of this paper is to present the information society in Slovenia, particularly the use of information and communication technology in the Slovenian higher education system in comparison with the other European Union (EU) and associated member countries. We also point out the advantages and potential disadvantages of e-learning in comparison with classical way of learning.

The main contribution of this paper is twofold. First, it presents the current stage if development of the information society in Slovenia, focusing on e-learning. Second, it compares the Slovenian developments with European coutries, particularly members of the European Union (EU).

E-learning is a term, used to describe a modern way of education, specialization and training, facilitated through the use of information and communication technology or the Internet. The main characteristic of such mode of study is the fact that a student and a teacher can be spatially and temporally separated but they, nevertheless, communicate with each other. E-learning and long-distance learning are not a recent phenomenon. Both are used in most developed countries,

especially in adult education. One could say that in the modern world both modes of study and training are fairly common and equal to the traditional course delivery. That is why e-learning is also undergoing a successful integration process into the Slovenian higher education system. The main aim of the e-learning is to modernize the pedagogical process in line with the current world trends. E-learning enables students to approach their studies individually. It further increases the motivation for successful work that improves students' progression. Therefore, the study becomes more appealing, at the same time the quality of teaching is further increased. The integration of e-learning enables the rationalization of modules and hence the implementation of the pedagogical process at various locations.

The rest of the paper is structured in the following way. First, we introduce the main stylized facts on information society in Slovenia in comparison with some more developed EU countries. Here we present the main characteristics of the Slovenian information society. Then we analyze e-learning in Slovenian higher education in comparison with classical way of learning. Furthermore, we compare the evidence for Slovenia with some other European countries. We also present Moodle, the most common software for application of e-learning. Finally, we derive main conclusions with advantages and disadvantages.

INFORMATION SOCIETY

The information society is changing the world as well as the Slovene society. Therefore we should be aware of these changes and embrace them. The expansion of e-learning is one of the characteristics of the information society by which we can also estimate the level of its development. In this part of the paper we will present the empirical evidence on some basic indicators of information society in Slovenia during the most recent years and on the use of Internet by different age groups in Slovenia in comparison with developed EU countries.

E-LEARNING IN SLOVENIA

In general we can say that e-learning is a learning with the use of computer and new electronically and digital technology. For instance, in the schools at all levels the e-learning is used as World Web as an additional source of information. Moreover, it helps us to conduct the distance learning. On the other side in the enterprises with the use computer applications we can provide different trainings, courses and other education activities. Here we can point out the individual way of getting new knowledge and skills. The participants in the process of education can decide when and where they want to study. They can create own time schedule for study. So they can be more successful in time management.

In Slovenia the pioneers of a distance learning and e-learning are professors at the Faculty of Economics and Faculty of Electrical Engineering at the University of Ljubljana (http://www.e-studij.net/). A special focus in this part of the paper is on the analysis of the empirical evidence on the percentage of enterprises using e-learning applications for training and education of employees (without financial sector, 10 employed persons or more) in Slovenia in comparison with other European countries. Moreover, we will analyze the Internet availability and Internet use in the Slovenian households with a special focus on e-learning.

MOODLE

Moodle is free software that we can use to create web sites where teachers and students can communicate and collaborate. It is a course management system designed to help educators who would like to create quality online courses. It is used all over the world by universities, schools, companies, and independent teachers. Many institutes use Moodle for online courses, while some use it to augment face-to-face courses (known as a bladed learning). With Moodle we can deliver content to students and assess learning using assignments or quizzes. Moreover, we can create many different activities such as Forums, Wikis, Databases, and so on. This helps us to build collaborative communities of learning around subject matter.

Moodel has a large user community: on the Moodle site http://moodle.org there are over 596074 registered users, speaking over 78 languages in 201 countries. In 2006 there was developed an internet site http://www.moodle.si/moodle/ for Slovenian Moodle community. The aim of this site is to join the discussions about Moodle in Slovenia and abroad. It is a community site, where you can find information, free downloads, and detailed community discussions about installing, using and extending Moodle.

CONCLUSIONS

The new way of learning, electronic learning or e-learning, is a type of technology supported education. E-learning lessons are generally designed to guide students through information or to help students perform in specific task. E-learning can provide many benefits for schools and individuals. It allows people to avoid travel, it allows reduction of paper usage, and it is more environmentally friendly. Information is available internationally to anyone interested at minimum costs and the quality of education is higher. Moreover, learners are not bound to a specific time to attend classes and to learn.

But sometimes e-learning is not very successful. Some students are less motivated due to the environment of the application form. Especially individuals who are not comfortable with using technology or even do not have access to the technology. We also have to point out that the workload on the supervisors is far greater than in the traditional learning. Therefore it is very important that the supervisors and students are well motivated.

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E-Learning: The Effects of Computer Attitude, Statistics Anxiety, and Self-Efficacy on Statistical Software Adoption Behavior

Kevin K. Chiu, Lunghwa University of Science and Technology
kpb@hotmail.com
Maxwell K. Hsu, University of Wisconsin-Whitewater
hsum@uww.edu
Stephen W. Wang, National Taiwan Ocean University
stephen@mail.ntou.edu.tw

ABSTRACT

Educators need to know how to motivate business students (i.e., future business practitioners) to learn and use statistical software, which can provide the practical skills necessary for business professionals to analyze data and make informed decisions. Randomly selected 1,000 MBA students in Taiwan would be the sample of this study. A modified TAM model would be examined using LISREL 8.80. Empirical results expect to show significant interrelationships among Computer Attitude, Statistics Anxiety, and Self-Efficacy on Statistical Software Adoption Behavior. Both theoretical and practical implications will be discussed in this paper.

Key words: Computer attitude, statistical software self-efficacy, statistics anxiety, technology acceptance model.

INTRODUCTION

E-Learninig describes the application of technology to convey training and/or learning programs. The methods could be the Internet, software programs, multi-media, etc in instruction of curriculums or lessons. One of the amazing recent developments in e-learning in Taiwan is the extraordinary growth of online education. Online courses have expanded educational opportunities to employed individuals who need to advance their career but might not otherwise have easy access to a traditional face-to-face college program (Saade et al., 2008). An extremely conservative estimate is that at least four million individuals are currently involved in e-learning (www.ePark.org.tw, 2008), and the the compound growth rate is as high as 57% (Messina, 2008).

Since 2003, the number of e-learning suppliers has grown from less than 30 to approximately 200; on the other hand, the output value of this industry has increased from NT$ 700 million to 10 billion (www.ePark.org.tw, 2008). As noted in a recent publication, “the e-learning market in Taiwan is growing steadily as the government continues to invest in this industry. Over the next five years, the Taiwan government is planning to invest around $606 million (US) to develop Taiwan’s digital content market, in hopes that by 2011, the total production value of Taiwan’s digital content industry will reach US $18 billion. Much of the project is related to developing the e-learner market, with special focus in helping local companies partner with foreign companies with advanced technologies in e-learning” (cited from Messina, 2008). Alternatively,

the use of e-learning has been encouraged in governmental departments, universities and/or academic institutions, and businesses and/or industries.

Following this e-learning trend, both technology-centered companies (e.g., Cisco, IBM, and Dell) and non-technical companies (e.g., MetLife) have added e-learning contents to solve the employee training puzzle (Bisoux, 2002). Likewise, business schools are offering increasingly more technology-enhanced (hybrid) or technology-based (online) courses for working professionals (Gibson et al., 2008). Among the increasingly popular e-learning programs is the online MBA program, which has turned out to be a buyer's market in today's competitive business education marketplace. Given that many of the online MBA learners are full-time employees with plans of climbing the corporate ladder, it is important for educators to equip these business warriors with tools for making better business decisions through the use of business statistics on a computer. Surprisingly, though many online MBA students appear to be more capable, savvy, and demanding than traditional MBA students (Bisoux, 2002), little is known about online MBA learners' attitudes toward learning a challenging course (e.g., statistics) through computer technology (e.g., statistics software) (Ma et al., 2005). Therefore, the present study attempts to fill this need by examining the influential factors that may facilitate or hamper the adoption of statistical software.

Overview of the Framework

Courses in statistics are important to all business majors because they represent the only formal exposure to statistical analysis and research methods many students may find useful later in their careers. Analytical skills enhance students' ability to read, interpret, synthesize, and use reported results. On the other hand, research production skills enable students to design and initiate original research (Ravid & Leon, 1995). Students' experiences toward statistics, however, are often a source of anxiety producing negative perceptions, perhaps especially among those with 12+ years of schooling without ever taking a course in statistics.

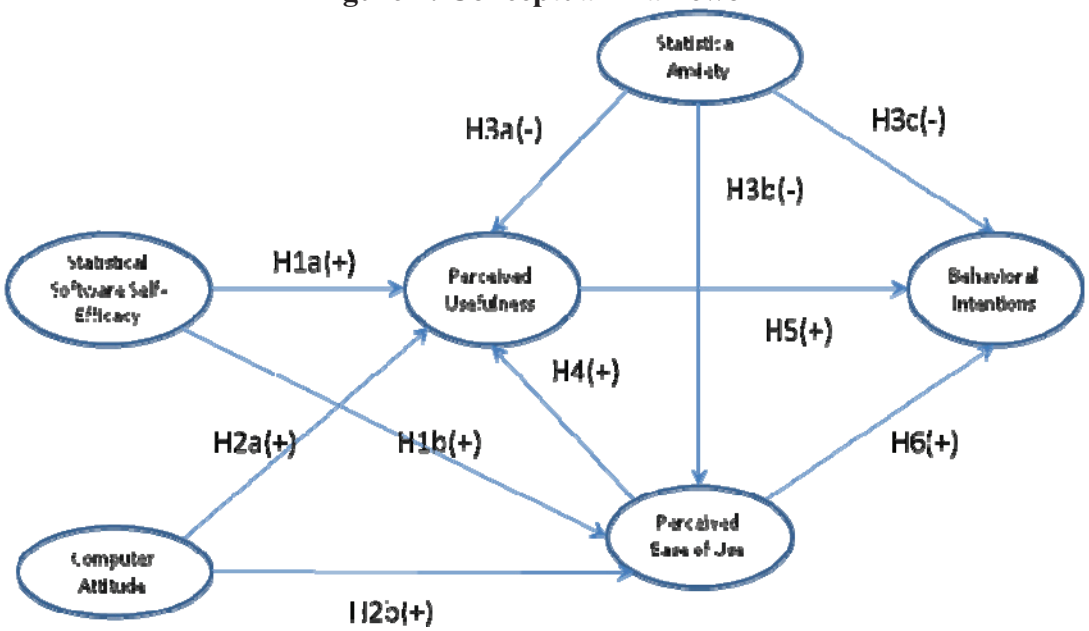
While an increasing number of college students are required to take at least one statistics course as a mandatory part of their degree programs (Onwuegbuzie & Wilson, 2003), a large proportion of these students report experiencing high levels of statistics anxiety with these classes. It is estimated that between two thirds and four fifths of graduate students experienced unmanageable levels of anxiety due to statistics (Onwuegbuzie & Wilson, 2003). Researchers have indicated that courses in statistics are among the most anxiety inducing, especially for students in non-mathematics-oriented disciplines (Schach & Stewart, 1991; Zeidner, 1991). Unfortunately, high levels of statistics anxiety have been found to debilitate performance in statistics and quantitative-based courses (Onwuegbuzie et al., 1997). Further, statistics anxiety has been documented as affecting college students' ability to acquire the skills, knowledge, and strategies necessary to interpret and critique research reports. This anxiety also affects their ability to propose, design, and implement research studies (Onwuegbuzie et al., 1997).

Other than statistics anxiety, it is intuitive that personal attitudes and opinions can influence the adoption of innovations (Rogers, 1995). Echoing this notion, Zanakis and Valenzi (1997) note that "attitudes and perceptions about statistics influence…the extent to which students use statistics in their careers" (p. 10). Therefore, the preconceived notion about statistics is thought to

have a sizable impact on online MBA learners' willingness and desire to take advantage of statistical software in their jobs, even when statistical analysis needs to be conducted.

To determine the extent for which external variables (i.e., computer attitude, statistical software self-efficacy, and statistics anxiety) influences user beliefs, and user beliefs influence their intentions to use statistical software, the interconnection between three external variables and behavioral intentions are assessed. Figure 1 represents a conceptual model depicting the behavioral sequence of perceived usefulness, and perceived ease of use as intervening variables between external variables and behavioral intentions.

Figure 1: Conceptual Framework



LITERATURE REVIEW

Among the required courses in most MBA programs, statistics is not necessarily a popular course, and it is often considered challenging by students. In the worst case scenario, learners may be afraid of the course or feel alienated. The result could be a lack of motivation and ability for learners to apply statistical concepts/tests that may enhance their capability of making a better business decision in their jobs. When inefficiently used, business statistics will not enhance one's creative thinking skills or improve performance within their organization. Being future-oriented, today's online MBA learners need to be armed with the ability to make the best use of statistics or at least to understand research findings on their own since they are likely to be tomorrow's business leaders. The following section will briefly review the technology acceptance model (TAM), which is one of the most widely used conceptual models in explaining and predicting the adoption behavior of Information Technology (IT). Subsequently, the endogenous and exogenous constructs used in our extended TAM conceptual model will be discussed.

TAM

As noted earlier, the primary objective of this research is to investigate the influential factors on the adoption and continuous utilization of statistical software among online MBA learners. To find possible influential factors for the adoption of a commercial statistics software package (i.e., a continuous incremental innovation not only in classrooms but also in offices), we first turn to the conventional wisdom in the information technology literature.
TAM was developed by Davis (1986) to explain the nature and determinants of computer usage. Two key components were found in the original TAM model: perceived usefulness and perceived ease of use (Davis, 1986). As articulated by Davis (1989), the former construct is referred to as "the degree to which a person believes that using a particular system would enhance his or her job performance," and the latter is referred to "the degree to which a person believes that using a particular system would be free of effort" (p. 320). It was postulated that actual system use is influenced by behavioral intentions to use, attitudes toward using the system, perceived usefulness, perceived ease of use, and external variables such as documentation, system feature, training, and user support (Davis et al., 1989). Davis et al. (1989) tested this posited model and found support to this general TAM structure. In particular, their empirical results showed that both perceived usefulness and perceived ease of use exhibited significant influence on intentions, while the former had a stronger effect on promoting the use of computer technology.

TAM has been validated over a wide range of systems (Igbaria & Iiravi, 1995; Igbaria et al., 1997; Karahanna & Limayem, 2000), has proven to have reliable and valid constructs (Doll et al., 1999; Chin & Todd, 1995), and routinely explains a considerable portion of usage intentions in various contexts (Meister & Compeau, 2002; Lee et al., 2007; Rao & Troshani, 2007; Turel & Yuan, 2007; Yiu et al., 2007). Over the past two decades, TAM has been widely used to study the predictive power of technology users' attitude toward their intention in adopting a new innovation. Quite a number of research studies have identified major external variables of TAM as system characteristics, computer self-efficacy, individual differences, and enjoyment (Davis, 1993; Hong et al., 2001-2002). Since perceived ease of use and perceived usefulness are two core variables in TAM, these two variables are employed to interpret online MBA learners' intentions to use statistical software in their jobs whenever appropriate.

External Variables

Though TAM has been identified as a useful model in a relatively wide range of applications over 20 years (Bagozzi & Richard, 2007), no research has used it to study the adoption behavior of increasingly user-friendly statistical software such as SPSS. Further, Walczuch et al. (2007) observed that "little effort has so far been made to combine personality-based and cognitive antecedents to technology use in one model" (p. 206). Accordingly, they hypothesize that the personality traits are antecedents to technology acceptance and their empirical findings show that "personality influences technology use" (p. 212). Thus, the current study extends Walczuch et al.'s (2007) work by examining the role of three personality traits (i.e., computer attitude, statistics anxiety and statistical software self-efficacy) in the context of statistical software adoption.

Computer Attitude

Although not being examined within the original TAM model, several studies have examined the relationship between computer attitude and IT use. Most theoretical models are based on Fishbein and Ajzen's (1975) theory of reasoned action, which suggests that an object leads to an attitude about it, and this attitude leads to behavioral intentions regarding the object. Consequently, these intentions affect actual behaviors toward the object. Attitude is "an index of the degree to which a person likes or dislikes about the object" (Ajzen & Fishbein, 1980). Based on this beliefs-attitudes-intentions paradigm, it has been hypothesized that computer attitudes affect users' behavioral intentions, affecting their computer usage (Rainer & Miller, 1996). A number of empirical studies have found significant relationships between attitudes about computers and usage of them (Compeau & Higgins, 1995; Thompson et al., 1991, 1994).

Attitude toward computers is a "broad and general" concept (Chau, 2001). Kay (1993) commented that with respect to measuring attitudes toward computers, it would be best to be as specific as possible about the content of the attitude object. Drawing from the results of prior TAM studies, it seems plausible to put perceived usefulness and perceived ease of use, the two key variables in TAM, as the mediating variables, between computer attitude and intentions to use a specific technology application. In other words, it is postulated that general computer attitudes affect the perceived usefulness and the perceived ease of use of a specific IT, which, in turn, affects the intentions of using that IT.

Statistical Software Self-Efficacy

In today's business environment, use of information technology by professionals in all functional areas of business organization is ubiquitous. In fact, colleges have recognized the need for computer training for business students (Shufeldt & Parmley, 1992). Recent research emphasized the importance of realizing that differences exist between academic disciplines (Chung et al., 2002). Computer self-efficacy is a variable that has been proposed and examined as an additional explanatory variable of an individual's IT usage (Compeau & Higgins, 1995; Igbaria & Iiravi, 1995). By recognizing relationships of statistical software self-efficacy among business professionals and students, prescriptive action may be taken by educators to provide proper statistical software usage supports or adequate training to future business professionals (Bates & Khasawneh, 2007).

Self-efficacy is defined as "the belief that one has the capability to perform a particular behavior" (Compeau & Higgins, 1995). This concept ''refers to beliefs in one's capabilities to organize and execute the course of action required to produce given attainments'' (Bandura, 1997) and is thought to result from past accomplishments, vicarious experience, verbal persuasion, and emotional arousal (Bandura, 1977). Individuals' self-efficacy levels influence their ability to acquire skills, choice of activities, and willingness to continue in a course of action. Self-efficacy has been shown to significantly influence a user's anxiety toward using computers and their actual computer use (Compeau & Higgins, 1995). It is our contention that identifying whether differences exist with regard to self-efficacy can help to explain successful statistical software usage.

Self-efficacy has been studied in psychology for decades (Bandura, 1997), and this construct was introduced to the MIS literature in the form of computer self-efficacy (Compeau & Higgins, 1995). Recent studies showed that self-efficacy is related to computer anxiety, training, learning performance, and computer literacy (Beckers & Schmidt, 2001; Chou, 2001). Computer self-efficacy has also been used as a proxy for an individual's internal control in IT usage context, (i.e. a user with a high level of self-efficacy tends to feel a stronger sense of control over the activities being performed) (Venkatesh & Davis, 1996). Chung et al. (2002) studied the differences in self-efficacy among students in the business, education, forest/wildlife, and liberal arts schools of a major university. They suggested further research into understanding computer self-efficacy.

Given that individuals who have high statistical software self-efficacy are more likely to use statistical software (Marakas et al., 1998), we propose that individuals with high statistical software self-efficacy would feel higher levels of mastery over statistical software applications.

Statistics Anxiety

Statistics anxiety refers to feelings of anxiety experienced by those taking a statistics course or undertaking statistical analyses, in terms of gathering, processing, and interpreting data (Cruise et al., 1985). Onwuegbuzie, DaRos, and Ryan (1997) have defined statistics anxiety more broadly as worry and emotionality occurring when students encounter statistics in any form and at any level. Statistics anxiety is situation-specific because it comes to the forefront when students are learning statistical concepts, terminology and formula or applying statistics in a particular context (Benson & Bandalos, 1989). Statistics anxiety has been conceptualized as being multidimensional (Cruise & Wilkins, 1980; Cruise et al., 1985; Onwuegbuzie et al., 1997). In particular, Cruise et al. (1985) identified the following six components of statistics anxiety: (a) Worth of Statistics, (b) Interpretation Anxiety, (c) Test and Class Anxiety, (d) Computational Self-Concept, (e) Fear of Asking for Help, and (f) Fear of Statistics Teachers.

Among the above six dimensions, the *Worth of Statistics* dimension refers to learners' perceptions of the relevance and usefulness of statistics. It is thought that *Worth of Statistics* is a key source of statistics anxiety among students since a few MBA learners raised the question, "Why is Statistics a required course in the online MBA program?" It is hypothesized that MBA learners who hold a more positive attitude toward statistics are likely to be more comfortable in using a statistical package in a class and later in their daily jobs.

Based on the above discussion, we posit the following hypotheses:

H1a: The higher the perceived level of statistical software self-efficacy, the higher the level of perceived usefulness of it.

H1b: The higher the perceived level of statistical software self-efficacy, the higher the level of perceived ease of use.

H2a: The higher the perceived level of computer attitude, the higher the level of perceived usefulness of the statistical software.

H2b: The higher the perceived level of computer attitude, the higher the level of perceived ease of using the statistical software.

H3a: The lower the perceived level of statistical anxiety, the higher the level of perceived usefulness of the statistical software.

H3b: The lower the perceived level of statistical anxiety, the higher the level of perceived ease of use of the statistical software.

H3c: The lower the perceived level of statistical anxiety, the higher the level of behavioral intentions to use the statistical software.

H4: The higher the level of perceived ease of use with the statistical software, the higher the level of perceived usefulness toward the statistical software.

H5: The higher the level of perceived usefulness of the statistical software, the more likely one would continue to use the statistical software.

H6: The higher the level of perceived ease of use, the more likely one would continue to use the statistical software.

METHODOLOGY

Sample

Questionnaires will be administered to 1,000 randomly selected MBA students enrolled in a graduate level advanced business statistics course in Taiwan.

Measures

All constructs were measured from the respondents' perspective using a self-report, online, 7-point Likert type scale questionnaire, anchored by "strongly disagree" and "strongly agree." The proposed model consisted of six constructs: (1) statistics anxiety, (2) computer attitude, (3) statistical software self-efficacy, (4) perceived usefulness, (5) perceived ease of use, and (6) behavioral intentions. Questions included in the questionnaire were adapted from prior research studies. Specifically, the measures for two typical TAM variables (i.e., perceived usefulness, perceived ease of use) were adapted from Davis (1989). Among the four items used to measure behavioral intentions, the first two items were adapted from Chau (1996) while the remaining two items were added by the authors.

As to the three external variables, computer attitude was operationalized with six items adapted from Harrison and Rainer (1992). The measure for statistical software self-efficacy was adapted from Compeau and Higgins (1995). The measure for statistics anxiety was adapted from Cruise *et al*. (1985), who used Factor Analysis to categorize eighty-nine question items into six dimensions: *Worth of Statistics*, *Interpretation Anxiety*, *Test and Class Anxiety*, *Computation Self-concept*, *Fear of Asking for Help*, and *Fear of Statistics Teachers*. In order to avoid the issue of data fatigue among the respondents, we consulted three experienced researchers in the field of MIS and Statistics, deliberately selecting eight questions (out of the sixteen items) from the first factor (i.e., *Worth of Statistics*) to represent the concept of statistics anxiety, which generally indicates "a negative attitude toward statistics" (Cruise et al. 1985). Table 1 and Table 2 summarize the items related to each of the six studied constructs.

Table 1. The Survey Instrument--Endogenous Constructs

Items	Item-Construct Loading		Cronbach's Alpha	Average Variance Extracted
	Standardized	t-statistic		
Perceived Usefulness				
Using a statistical package such as SPSS can improve my job performance.				
Using a statistical package such as SPSS can make it easier to do my job.				
Using a statistical package such as SPSS in my job can increase my productivity.				
I find a statistical package such as SPSS useful in my job.				
Using a statistical package such as SPSS would enable me to accomplish statistical analysis more quickly.				
Perceived Ease of Use				
I find it easy to get SPSS to do what I want it to do.				
My interaction with SPSS is understandable and clear.				
I find SPSS to be flexible to interact with.				
It is easy for me to become skillful at using SPSS.				
Behavioral Intentions				
I always try to use statistical software such as SPSS to conduct a task whenever it has a feature to help me perform it.				
I always try to use statistical software such as SPSS in as many cases/occasions as possible.				
Statistical software such as SPSS has lots of exciting functions that I intend to use.				
I intend to increase my use of statistical software such as SPSS in the future.				

Table 2. The Survey Instrument--Exogenous Constructs

Items	Item-Construct Loading		Cronbach's Alpha	Average Variance Extracted
	Standardized	t-statistic		
Statistical Software Self-efficacy				
I could complete a statistical analysis using statistical software such as SPSS…				
if I had seen someone else using SPSS before trying it myself.				
if I could call someone for help if I got stuck.				
if someone else had helped me get started.				
if someone showed me how to do it first.				
if I had used similar software before this one to do the same job.				
Computer Attitude				
Computers are bringing us into a bright new era.				
The use of computers is enhancing our standard of living.				
There are unlimited possibilities of computer applications that haven't even been thought of yet.				
Computers are responsible for many of the good things we enjoy.				
Working with computers is an enjoyable experience.				
Statistics Anxiety (Attitudes toward Statistics)				
I wonder why I have to do all these things in statistics when in actual life I'll never use them.				
Statistics is worthless to me since it's empirical and my area of specialization is philosophical.				
I feel statistics is a waste.				
I don't want to learn to like statistics.				
I wish the statistics requirement would be removed from my academic				

program.

I don't understand why somebody in my field needs statistics.

I don't see why I have to clutter up my head with statistics. It has no significance to my life work.

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An Investigation into Data Collection Technology in the Construction Industry

Chang-tseh Hsieh **,University of Southern Mississippi
Chang-tseh.Hsieh@usm.edu

Binshan Lin, Louisiana State University – Shreveport, Shreveport
Binshan.Lin@lsus.edu

ABSTRACT

Data collection is one of the most challenging tasks confronting project manager in the construction industry because most jobs are on strict deadlines and require very high levels of organization, as well as coordination. Companies have been plagued by wasted resources and lost work time due to miscommunications in scheduling, estimating, and delivery. Most of these problems can be alleviated if not totally eliminated by using the appropriate data collection technology. This study will examine data collection technologies that may be implemented to improve operation effectiveness and efficiency in the construction industry.

INTRODUCTION

A variety of electronic data collection technologies have been widely used in such areas as retail businesses, healthcare industry and most service type industries to great success (Clemons, 2007). Most of these technologies, however, have long been overlooked by managers in construction companies of all sizes. Management in this industry tends to consider the data collection as a trivial and routine job, and never bothered to examine the potential benefits of applying these technologies.

For examples, modern day data collection technologies can be used in material tracking, resource allocation, payroll/accounting, units in place, and even inventory management at a typical construction company. And, more advanced data collection technologies can even be used in strategic planning processes for construction company, but their potential importance have largely been ignored in this industry.

This paper will survey variety types of data collection software and hardware available, to examine how they can be implemented in the construction industry. It will show how using this type of technology can save valuable time and money on the jobsite. A review of existing related studies will be conducted, followed by the survey of those technologies that may improve data collection activities in construction industry. Some managerial implications will then be presented. A summary of major findings and the directions for future research will conclude this report.

LITERATURE REVIEW

Although Construction is a $3.2 trillion industry per year it ranks 87th within industries worldwide in the adoption of technology. With the widespread introduction of wireless technologies, the construction industry stands to benefit a great deal. A research firm called Daratech has estimated that five to ten percent of a construction project's cost can be saved by using web based technologies. This is a huge amount of money considered that most commercial construction projects cost millions of dollars. The wireless transmission of information on a jobsite allows for faster more accurate communication ranging from timekeeping, payroll, equipment tracking, work-in-place, work-in-progress, and productivity (Pantoya, 2002).

Despite the importance of data collection in construction industry, very little researches about the data collection technologies have been done, especially in academe. Early works on data collection issues in industry primarily focused on techniques of automated data collection in building (Davison and Miroslaw, 1995, Phair and Roe, 1998, Björk, 1999, Phair, 2000) Lately, the focus shifted to GPS application (Lee and Han, 2003), and the use of wireless technologies to expedite the collection and transmit of data (De La Garza and Howitt, 1998, Pantoya, 2002, Ward, et al, 2004, Nuntasunti and Bernold, 2006, Tsai, et al, 2007).

The latest wave of studies on data collection technology has been related to the application of the radio frequency identity tool (RFID). This is the technology that attracted most attention in construction industry. Many reports have been published to address the technogy in generaly and the specificvalues for data collection in construction industry (Goodrum, et al, 2006, Smith, 2007, Clemons, 2007, VeriChip, 2008). To examine wich technology maybe of the greatest potential value for construction industry, an investigation into the detail of most relevant data collection technologies would be needed.

Data Collection Technologies in Use

The implementation of a wireless data collection system on a jobsite allows for easy access to construction data, enhances information flow on the job site, cuts remedial cost, and aids in completing a contract to it's specifications (Ward, et al, 2004). This technology also proved to be cost effective and can generate substantial savings using a site based data-capture system. The system proposed by Ward, et al was made up of hardware, software, and communications tools. A three part system was developed to make possible the real-time data capture for the installation of construction site piling. This system consisted of:

- site based server-side database;
- IEEE 802.11b wireless local area network;
- wireless thin-client devices;

This system was developed due to a need to provide real-time data capture for the placement of piling, and additional needs as summarized below:

- The need to reduce defective work caused by partial, unclear, replica, misplaced or false information
- Awkwardness of bulky paper documentation
- Lack of verification on the data collected
- Mistakes in data translation between the site and office
- Lack of using historical data throughout the company
- The ability of the system to react to changing conditions on a jobsite

Using data collection technologies on jobsites can reduce operation times, but it can still include sub processes that can affect information transmission and production. Implementing speech technologies for on-site data collection was suggested to help improve cooperation between construction workers and application devices. It was also demonstrated that this system increased productivity, reduced operation time, and simplified sub processes for the completion of activities (Tsai, et al, 2007).

Portable data collection devices can be categorized into two categories. These categories are measuring devices and data logging devices. Measuring devices typically use laser range finders in the construction industry for surveying (Venmore-Rowland, et al, 1991). These devices make the task of surveying much easier and more efficient than when performed using standard measuring tools. Many hand held devices, however, have a downside by having very small keyboards which makes entering data on the jobsite very difficult. Fortunately, many devices are developed to be used with a bar code reader which eliminates the need for difficult data entry. There are also other keyless computers that have graphical interfaces and allow the user to hand write data into the device (Venmore-Rowland, et al, 1991). It has been shown that handheld wireless devices can eliminate the need for many hard copies of reports that have the potential to be lost.

The use of GPS to transmit data in earthmoving systems has recently gaining more attention to managers in construction industry. This technology is currently being used to effectively cut cost and raise productivity. In this system the machine operator has a screen that guides him while performing earthwork on the land. The operator is able to receive information on the amount of cut and fill conditions with precise grades. Traditionally this information had to be obtained from performing surveys on the land, which can be very time consuming. By implementing this GPS technology the procedure is simplified, and automated work task are deleted (Lee and Han, 2003).

Data collection technology can also be used in tracking location, idle time, work time, and service alerts of a vehicle on a jobsite. This system consists of a small computer, concealed inside a vehicle, and a transmitter to receive and send data. The information is then downloaded to a computer each day and can be checked by management. This system allows supervisors to make sure that equipment is being used properly and is not experiencing costly downtime or improper use on the jobsite.

One recent technology that has helped advance the field of data collection is Radio Frequency Identification (RFID). RFID is sometimes confused with or seen as a better version of the bar

code. Construction projects use bar codes for many purposes such as identification, tracking, and cost. Bar codes are great but they do have their limitations. While bar codes use light to read information RFID technology uses radio waves to send information between components. Barcodes are more efficient and accurate than manual data collection, while RFID has many advantages over barcodes (Davidson and Skibniewski, 1995). The identification tags used to store information can be either active, uses a battery, or passive, using the readers power. Some of the main advantages of RFID is its superior data collection ability, ability to read data even when the identification tag is out of sight, they are very difficult to copy, and they are extremely rugged, which is a must in the construction industry (VeriChip Corporation, 2008).

Large retail chains such as Wal-Mart are already implementing RFID on a large scale. They recognize the advanced material tracking abilities of RFID. RFID technology basically consists of a tag that stores information that is then read by an RFID reader. This information can be transmitted from very close distances up to hundreds of feet away. This technology allows the user to keep track of merchandise, machinery, tools, or even equipment using a simple reader. As mentioned earlier Wal-Mart uses this type of technology to track their shipments and inventory (Smith, 2007). Large amounts of time are spent on construction jobsites looking for parts and subassemblies everyday. Many companies are still using paper tracking systems where parts are found according to their part number and then checked off. This method is very slow and highly susceptible to human error. Even after the item is found it is often unclear as to where it belongs and how to install it (Furlani and Stone, 1999).

RFID can be used to keep up with costly tools on the jobsite. Traditionally a tool is not considered missing unless it is needed to complete a project and cannot be found. This causes for costly downtime as well as a loss in productivity. With the implementation of RFID chips on many of the tools at jobsites the superintendent can account for all tools at the end of the day by checking his PDA. This decreases the chances of losing a tool and allows for faster replacement of missing tools. Not only can the tools be accounted for, but they can also contain information concerning their cost, type, and location embedded in their chips. This gives the project manager a better idea of the type and value of all tools being used on the jobsite (Goodrum, et al, 2006).

In a recent study conducted by DeWalt tools it was found that the top three concerns on a jobsite were replacement cost, lost time, and decreased productivity. Furthermore the National Insurance and Crime Bureau reports that the construction industry losses around one billion dollars annually due to equipment and tool theft. This number is increasing at an estimated twenty percent per year (VeriChip Corporation, 2008).

Figures 1-6 below illustrate how a tool/part tracking system might work.

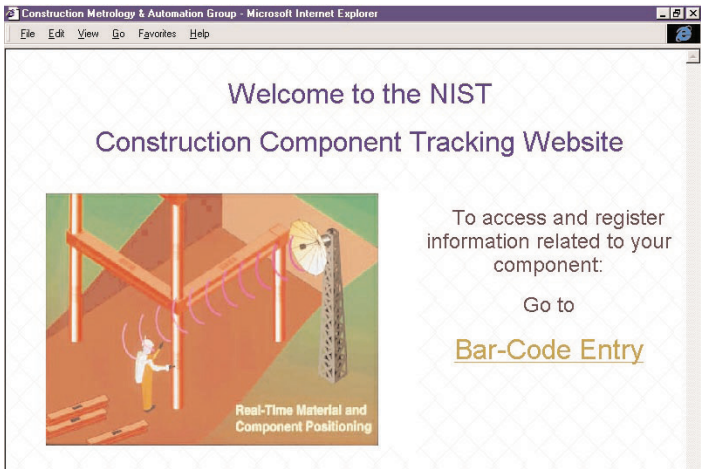

Figure 1: NIST home page

Figure 1 is the NIST software's homepage. This particular software only has an option for bar-code entry but other softwares would have an option for RFID entry.

Figure 2: Using bar code scanner for a large I-Beam

Figure 2 show an example of a woman scanning a bar code for a very large I-Beam. This data is then transmitted to the material tracking software. This could also been done using RFID scanners.

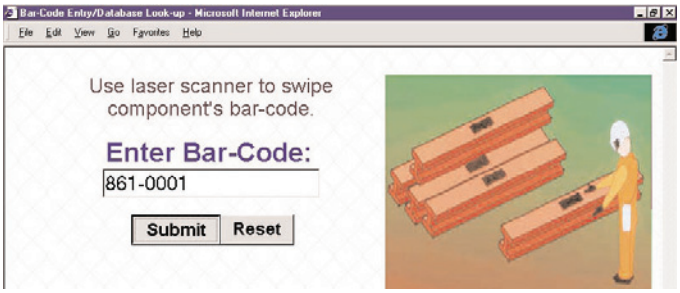

Figure 3: Bar code captured and ready to be transmitted

Once the part is identified a screen showing the bar code is available to submit the part number to obtain more information (Stone, et al, 2000).

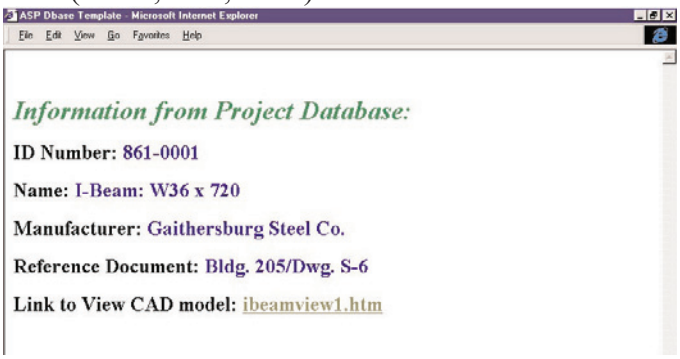

Figure 4: Display of information pertaining to the scanned item

Once the part data is received the user can view statistics including name, size, reference, manufacturer, and even a link to view the part in a 3-D model. Figure 3 shows the typical information pertaining to the scanned item retrieved from the database. The displayed information includes a link to the 3-D view of the item as illustrated in Figure 5 below.

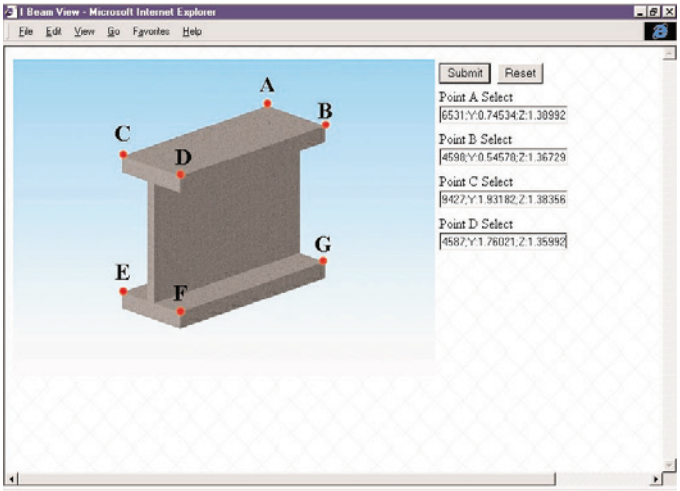

Figure 5: 3D view of the scanned item

The 3-D view of the scanned part allows the inspector to check for accuracy. The inspector can then measure the I-beam to check for accuracy as illustrated in Figure 6 below (Stone, et. al, 2000).

Figure 6: Inspector measuring the I-Beam to check for accuracy

Throughout many years most construction job sites have relied on the walkie-talkie to transmit information and communicate on a job site. With the developments and ease of implementation of current wireless systems this trend could easily be replaced or deemed old technology. There are ten categories in which all information needs on a jobsite can be put into. These categories are request for information, materials management, equipment management, cost management, schedule and means and methods, jobsite record keeping, submittals, safety, quality control, and future trends. Furthermore jobsites would most likely need to communicate using live voice, live video, live data, and stored data using wireless technology (De La Garza and Howitt, 1998). Live video could be used to monitor the jobsite so that employees in the home office would be able to watch the progress of the project to have a better idea of it completion status. This video is also great for security purposes. Figure 7 below is an example of how a camera network could be set up at a construction site.

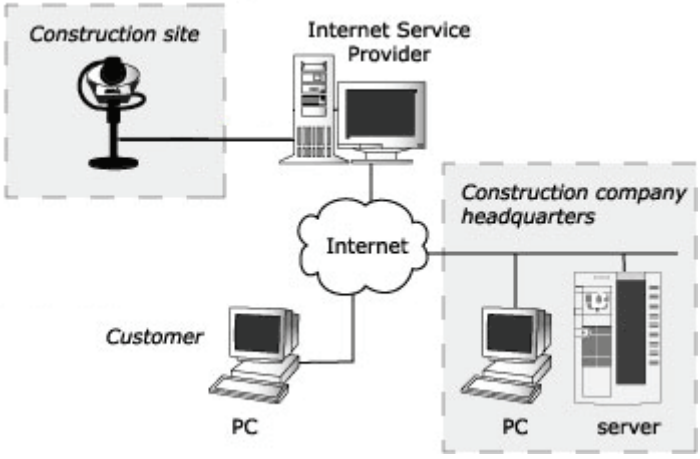

Figure 7: Setting a camera network at a construction site

As shown in Figure 7, such a system allows the customer, as well as the construction company, to monitor progress of projects on a real-time basis.

Live data transfer is an area that is very important on a construction site. In the past workers would have to make reports so that management could determine what percent of an activity was completed. Live data transmission allows for supervisors to transmit data directly to and from the jobsite, which can aid the construction process immensely. One area where this live data transmission can greatly aid a construction company is through on-site time-keeping. Traditionally workers would have to use a timecard to clock in and out. This method has many downfalls. All of the workers cards have to be organized and kept up with everyday, as well as entered in to the payroll system.

With the addition of a time-keeping system such as Data:Maxx a construction companies payroll process can be virtually automated. The Data:Maxx system works in conjunction with most popular payroll programs, accounting packages, and spreadsheet programs (DataMaxx Technologies, 2008). There are even softwares available that are designed to pick the best accounting package for a construction company (Roe, 1999). This software is then paired with a data collection device that is offered by Data:Maxx. One option for collecting the data is by using a cell phone that has been java enabled; also an optional barcode reader can be adapted to many cell phones.

Another option is to use a PC as the time clock. It can be formatted to work with touch screens, swipe card readers, or code entry stations (DataMaxx Technologies, 2008). Yet another option is the stand alone badge reader that can be placed on the jobsite. This reader allows workers to swipe their badges upon entering and exiting the jobsite. This information is then seamlessly inputted into payroll or accounting software. Another similar more secure option is the biometric reader. This device usually scans a workers finger print to ensure their identity, which prevents workers from clocking in for one another (Kronos Workforce Management, 2003). Systems such as Data:Maxx not only improve the time-keeping / payroll abilities of a company, but they also allows for the tracking and monitoring of equipment usage (DataMaxx Technologies, 2008) . All of this is made possible through the electronic transmittal of information. Figure 8 below is an example of how a handheld PDA could be used to communicate with the home office during a construction project.

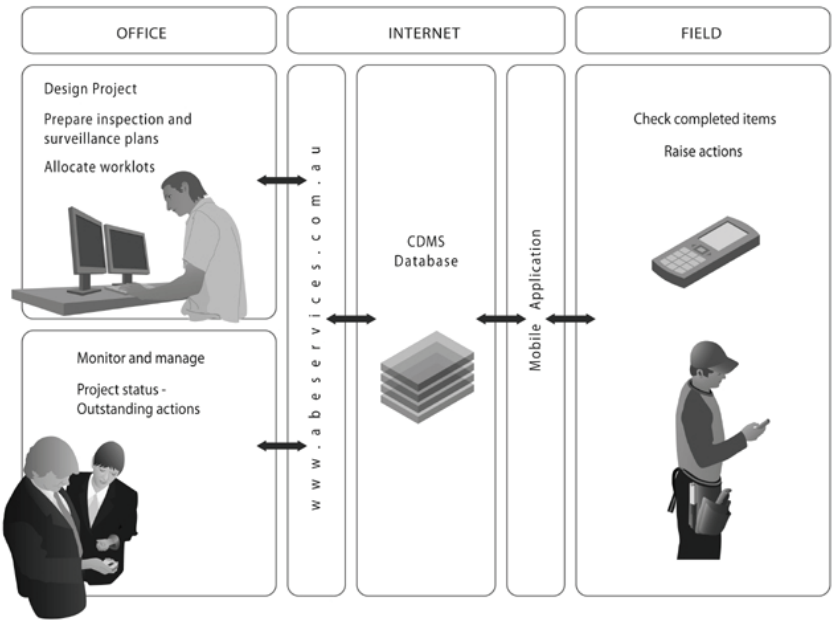

Figure: Example of using PDA for a construction project

As seen in the diagram above the manager on-site is able to receive information concerning the project immediately from the home office as well as transmit progress reports to the office.

One other new type of data collection technology being used in construction is the 3D laser scanner. The construction site is scanned using a laser scanner which is able to estimate the amount of work completed in between scans. This technology should greatly improve the speed of determining a projects completion (El-Omari and Moselhi, 2001).

Results Summary

It is clear that the whole construction industry is moving towards wireless communication and automated processes. Due to the construction industry being so competitive it is imperative that companies are able to adapt quickly to new more efficient technologies. If they do not adapt other companies will be able to complete work more efficiently and in time overrun the slower less efficient companies. One view that was universal throughout my research was that these technologies often have a high cost to implement. Although their original cost may be high it is proven that over time the technology more than pays for itself. For some companies this time period may be one project for others it could be many years, depending on the type of technology implemented and the work to be done.

Ward, et al has introduced a construction company implemented a mobile site level data collection system that was configured for collecting and sending data concerning piling works by utilizing IEEE 802.11b wireless protocol. This particular system made real time data collection and storage possible. This in turn allowed managers to quickly and easily review the data concerning the pilings (Ward, et al, 2004). A cost-benefit analysis was performed to determine

the cost savings on corrective works by implementing this site-based data capture system. This cost-benefit analysis looks at the cost of implementing the system versus the value of the project and the potential cost of corrective work, resulting from defects. The cost of corrective work was estimated by finding the average of defective work from other company projects, which provided an accurate baseline (Ward, Thorpe, Price, and Wren 308). Table 1 below presents data about the cost analysis of implementing the piling data collection system on this particular project.

TABLE 1: Cost analysis for Kings Cross Implementation	
Contract Value	£10,500,000
Number of piles	575
Average Cost per Pile	£18,000
Baseline cost of remedial work (X) (0.97% of Contract Value)	£102,000
Actual cost of remedial work (Y)	£20,000
System implementation (Z)	£20,000
Saving (X-Y-Z)	£62,000

The above table suggests a 75% reduction in corrective works, which would reduce the baseline value of such work to 0.2% of the contract value. This particular company has a turnover of around £50 million per year which would mean that they could possibly save £385,000 per year if they were to implement this system throughout their company. This particular system provides three times its original cost in savings for one project alone. This example shows that data collection technology may be expensive upfront but it often will pay for itself in only one project (Ward, et al, 2004).

This next table shows the cost-benefit analysis of a hypothetical project using on-line video meetings to eliminate 66% of the physical meetings associated with a project (Nuntasunti and Bernold, 2006).

Table 2: Cost-Benefit Analysis for 66% Meeting Substitution

Item		Cost ($)	Benefit ($)	
Hardware		2,857		
ISP Fees	12 months · $250			
		3,000		
Maintenance	52 hours · $50/h	2,600		
Time spent online (10 min/day/person)	26 participants · (250 work days · 10/60) × $50/h	54,167		
Total Cost				−$62,624
Person-hours for weakly meetings	34 meetings · 6 participants · [(3 hours · $50/h) + $40 travel]		38,760	
Fixed cost/meeting	34 meetings · $80		2,720	
Person-hours for monthly meetings	8 meetings · 20 participants · [(4 hours · $50/h) + $40]		38,400	
Fixed cost/meeting	8 meetings · $80		640	
Total benefit				$ 80,520
Overall savings				$ 17,896

Figures in table 2 suggest that the total cost of the 66% reduction would be -$62,624 while the total benefit would be around $80,520 which equals an overall savings of $17,896. This savings is mostly due to the Person-hours saved for weekly and monthly meetings (Nuntasunti and Bernold, 2006). This system provides a more efficient way of conducting meetings, by keeping everyone connected wirelessly.

Management Implication

As mentioned earlier implementing data collection systems throughout a construction jobsite can greatly aid a manager. In the past managers had to keep track of materials, workers, machines, and progress all by paperwork or limited technology. Due to recent advances in wireless technology and tracking systems such as GPS and RFID managers can efficiently monitor all of these areas much easier than before. Better management results in faster more efficient work. It also helps to cut back on unproductive activities and lost time due to failures in communication.

Data collection hardware and software can be used in many facets of management. For example managers can use it to automate payroll, monitor work in progress, track equipment, assist in on site activities such as grading, and to greatly improve communication. One major area that wireless data collection technology can benefit businesses of all sizes is in the area of employee timekeeping. Hardware such as card swipes, fingerprint scanners, employee id entering systems, RFID cards, and others will allow the user to clock in and out of the jobsite with ease. Then the software included in the system will gather the information from the hardware devices and input it into the required systems. This timekeeping system can also be integrated with other systems such as payroll so that less manual entering of data is required. Overall this aids management in better controlling construction projects especially when a large amount of synchronization is required.

CONCLUSION

When managers have improved control over their resources they are able to perform at higher levels. The data collection tools that have been mentioned were designed to aid companies to be more efficient and in turn make more profits. As discussed earlier the construction industry is very slow to adopt new technology when compared to other industries. The industry is ranked 87th worldwide in the adoption of technology (Pantoya, 2002).

Many construction companies are set on doing things the way they know and are very weary of new technology. Furthermore from my experience it seems that many workers have a negative attitude toward learning new technology. Although the trend is starting to shift toward increased acceptance of technology, there is still research that could be done to access the reluctance of companies to adopt technology. More research could be done regarding the average useful life of new technology in the construction industry.

Most construction companies would probably continue to use their current technology even after newer technologies become available. It would be interesting to see how much money on average companies were losing by not switching to new technology. Even though there is a steep learning curve and substantial investments required to adopt some of these technologies it is very evident that they make workforces more productive and efficient. It seems that in order to survive in any industry, in today's times, it is necessary to not only accept modern technology but to embrace it as well.

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TECHNONLOGY INNOVATION AND OPEN LEARNING ENVIRONMENT

Dr. Natalija Komljanc, The National Education Institute
natalija.komljanc@zrss.si

ABSTRACT

Technology Innovation & Open Learning Environment, also Industrial Management (TIIM) 2009 aims to promote exchanges, discussion, and dialogues on how to manage schools with industrial operations and organizations in more innovative, effective, and productive manners.

The roles of holistic approach as well as an integration of human capital and organisational cultures in lifelong learning education in everyday life will be outline so that adaptations, learning, and improvement of research, practical examples will be made.

For example, the "Babushka" system is a strategy of implementation of the whole curriculum into practice. The system allows mutual activity of modernization directions from "top down" and from "bottom up". The key of success is in the system of babushkas when the first one fits into the next one. What is important is the order of precedence and the beginning of putting babushkas into the bigger one respectively. First implementation needs to start being occupied with self-regulative mechanisms so that the differentiation of lessons can transform into a form of bringing social learning groups closer together. This is followed by transformation of rules into principles. All this is necessary for creating integrative, holistic curriculum, which takes its multilayered characteristic into consideration. Only the whole gives us opportunities for effective sustainable or lifelong learning. Each element of the "Babushka" system works as a didactical principle.

Keywords: Innovation management, Open learning environment, Human capital, Knowledge management, Share management

2009 THE YEAR OF CREATIVITY AND INNOVATION

The European Year of Creativity and Innovation (2009) was proposed by the European Parliament and the Commission. The following recommendations are used as guidelines:

1. All forms of innovation, including social and entrepreneurial innovation, should be taken into account;
2. Raising awareness of the importance of creativity, innovation and entrepreneurship for personal development, as well as for economic growth and employment;
3. Fostering entrepreneurial mindsets, particularly among young people**,** through cooperation with the business world;
4. Raising awareness among people, whether inside or outside the labour market, that creativity, knowledge and flexibility are important in a time of rapid technological changes and global integration for a prosperous and fulfilling life; and equipping people to improve their career opportunities in all areas where creativity and a capacity for innovation play an important role;
5. Promoting closer links between arts, business and schools and universities; (European Year of Creativity and Innovation by the European Parliament, 2008).

Slovenia is on a good way to reach European average position in developing innovations. Momentarily, it is on the level of "moderate innovators" (third level from the top) and could catch up the European "innovation leaders" in thirteen years (data from The Innovation policy initiative PRO INNO Europe www.proinno-europe.eu). Slovenia has relative stability in the country groupings, over all long time period. In the category "innovation drivers" Slovenia is very near European average, in the category "knowledge creation" it is a bit below European average, in the category "innovation and entrepreneurship" it has very low position, in the category "application" it is also a bit below European average and in the category "intellectual property" Slovenia has very low position. The data facilitate us to do holistic approach as well as an integration of human capital and organisational cultures in lifelong learning education in everyday life - new strategy for "innovation society" in Slovenia.

THE NATIONAL VISION OF DEVELOPMENT IN SLOVENIA

The vision of the National Research and Development Programme is to create new knowledge, to transfer internationally accessible knowledge for the public good and for economic consumption, and to increase capabilities for mastering technological advances as the main source of national competitiveness and social and human progress. The enhanced stimulation of joint efforts between the research and business sectors, and stronger initiatives for joint R&D projects between science and business are needed in Slovenia. Research and development must first and foremost contribute to the advancement and success of the country and its citizens.

The priority emphasis is on those scientific fields which are vital for the maintenance and development of the state and the national identity. Through its various measures, the programme is oriented to the quality and effectiveness of research in Slovenia. It stimulates the mutual linking of education, research and entrepreneurship and improves the mobility of knowledge, ideas and people within society. Parallel to this, other policies must ensure a social and economic climate which generates demand for knowledge and creativity, provides increased public investment, and motivates the private sector to boost its investment in research and development, to promote its co-operation with research organisations, employ top professionals and to begin to look at R&D as an investment.

There are at least two main objectives of this programme. The first is to strengthen human resources in R&D and increase their humanistic orientation by educating young people in the spirit of free and open creativity, curiosity and awareness of the importance of personal knowledge and the second is to develop a supportive environment for R&D by cultivating a modern understanding of the role of knowledge and science in social and economic development as a key investment for social and economic advancement, and by creating a friendly environment for making bigger investments in science, technology and entrepreneurship (National Research and Development Programme 2006 – 2010, 2005).

LIVING IMPROVEMENT FOR SUSTAINABILITY IN LIFELONG LEARNING

The notion "living" includes the life of a person in a community, his education and managing his work, dialogue with himself for the adjustment of balance among himself, nature and

society. Education does not affect only school curriculum but life as well. For a balanced living an individual is constantly adjusting in a social group, nature. People adjust on the basis of realizations in the process of researching. We research as we compare (for example: we analyze, sort out, separate, bring closer…). We let each other know about the findings. Thus we bring ourselves up, develop permanent, applicable knowledge which we pass on from generation to generation. In this way teachers and parents train the younger for independent living and occupational activity in the living environment. The environment of the older devotes time and means to the cultural and humane life by spending the free time and gaining goods and cooperating with wider surroundings in the permanent development of lifelong learning. Schools form a more steady economy for living with the contents and method of learning and teaching (Komljanc, 2007c).

ADJUSTING OF A CHILD, AN ADULT AND SCHOOL FOR SUSTAINABLE KNOWLEDGE

School about the skills of adjusting, the intellectual development of a person as a consequence of active interaction with the surroundings, is developed by Piaget (1963 in Komljanc, 2008). He mentions that the intellectual development is carried out in the form of a process of assimilation when new objects, situations and ideas are understood by a student in the frame of a mind scheme which he already possesses (that is the firm part of a mind scheme) and adaptation when a mind scheme is supplemented, expanded and reformed into a completely new one (that is the change in his mind scheme).

Ausubel (1963 in Komljanc, 2008) terms the changes in a mind scheme as the so-called progressive (advanced) differentiation (distinction). Assimilation includes experiences. Adaptation develops itself on the basis of different techniques and methods of comparing new mental structures with the previous one.

School and a teacher are considered as excellent if they serve a student with experience on time (critical period). These experiences are/should be consistent with his previous mind schemes – with a student's prior knowledge. Likewise, school and a teacher should, at the same time, offer opportunities for creating new mental structures in an appropriate way – for example, making permanent knowledge firm in the way which they offer (the area of near development of previous knowledge oz. zona of proximal level development) (Vygotsky, 1979, in Komljanc, 2004).

MAKING LESSONS MORE MODERN

The main difference between the school of the 20th and the 21st century is not just discovering new theories of learning and teaching but the cultural enriching, refining performance curriculum with personal life in the living environment, with the living environment being expanded by moving persons, information, ideas, products and innovations. This is why the future of learning and teaching will direct itself not only to the contents but also to the strategy of changing and presenting and evaluation of achievements as well. It is reasonable to refine, enrich the previous and alternative tradition of learning by innovative strategic

approaches. Life – living should become innovative, namely by repeating, which carries in itself each time a new challenge. For this purpose, it is sensible to understand tradition and alternatives, to know how to appreciate and use it respectively.

In the first place, a school needs to become a laboratory not only for students but for teachers as well, namely an open laboratory where they can express themselves in the field of art and research, when they can connect and use the two seemingly in the expression incompatible fields with each other and use, execute them in everyday life. First, a teacher will have to become a real inventor of the world, not only a fictive simulator in the learning environment. A school, opened to the surroundings is not necessary only for a student, who is just getting to know the world, but also for a teacher, who is distanced from the real world, and its needs in everyday living environment (Komljanc, 2008).

LIFELONG LEARNING, SUSTAINABILITY AND GLOBALISM

Society in the 21st century nurses permanence of knowledge with width and depth of gaining experiences through the whole life as opportunities for changes in mental structures of an individual. There are opportunities at school for the so-called sustainable (permanent) knowledge – for quality building of change in mental structures and their expression in the skills of saving problems of life. The school of the 21st century promotes in the development of sustainable knowledge or lifelong learning when a teacher is supposed to provide a student with new opportunities for novelty, not only for him but for the society as well, mental schemes as innovative solutions (Jelenc, 2007). This task, put in front of teachers as the standard of the school of the 21st century, is seemingly likeable but extremely demanding, even more so if the society has developed verified patterns in its tradition and if this is the society which is constantly pursuing the standard of wider global community (Komljanc, 2008).

Namely, the basic philosophy and the principle of lifelong leaning are providing conditions for the development of "learning society". The aim of lifelong learning is quality elemental formal education which gives clear and firm structure of basic knowledge and skills, especially cognitive by which a person can build knowledge with new experiences from everyday life on.

OPEN LEARNING ENVIRONMENT AS A CHALLENGE FOR CHANGING WORLD

Tom Bentley (1998) found out that the first time in history knowledge is the primary source of economic productivity. Technological progress, organizational change and intensified global competition have driven a shift from manual work to "thinking" jobs.
Economic structures of society are undergoing a dramatic transformation, but our education structures are lagging behind (Bentley, 1999). The dominant educational paradigm still focuses on what students know rather than how they use that knowledge. We must be able to do more than absorb and feedback information. A central challenge for the education system is therefore to find ways of embedding learning in a range of meaningful contexts where

students can use their knowledge and skills creatively to make an impact on the world around them.

Creativity is the application of knowledge and skills in new ways to achieve a valued goal. To achieve this, creative learners must have four key qualities (Bentley, 1999):

1. The ability to identify new problem, rather than depending on others to define them;
2. The ability to transfer knowledge gained in one context to another in order to solve a problem;
3. A belief in learning as an incremental process in which repeated attempt will eventually lead to success;
4. The capacity to focus attention in the pursuit of goal, or set of goals.

Creativity cannot be learned in a vacuum. It is a form of interaction between the learner and his environment. Learning environment that encourage creativity have characteristic such us: trust (secure), freedom of action (creative application of knowledge), variation of contexts (learners need experience applying their skills in a range of contexts), balance between skills and challenge (people are engaged in challenging activities), interactive exchange of knowledge and ideas (creativity is fostered in environments where ideas, feedback and evaluation are constantly exchanged), real world outcomes (creative ability and motivation are reinforced by the experience). Concrete outcomes change the way things are done.
We also need some radical changes to the education system. We must restructure the school curriculum to reflect forms of learning which develop creative ability. Main recommendations are (by Bentley, 1999):

1. Reduce National Curriculum Content by half in order to create space for a broader range of learning experience and achieving genuine understanding in each discipline;
2. Develop a curriculum model that includes extended project-based learning in a range of contexts;
3. Ensure that every school student has an IT based Learning Portfolio – the spine of a new lifelong learning career;
4. Appoint at least two school-community brokers to every school, to co-ordinate learning projects and placements, and create a network of information, support and learning opportunities;
5. Develop new skills specifications, based on clusters of skills, which should be integrated into the study of all subjects;
6. Reward and disseminate creative input by policy makers, teachers adjusting professional contexts and creating “innovation funds”;
7. Create a series of databases, linked to the National Grid for Learning the University for Industry to match learners with placement opportunities, mentors and ideas that they can apply creatively;
8. Develop new model of inter-disciplinary teaching and learning, and adjust teachers training courses.

Only radical action said Bentley (1999) will ensure the opportunities presented by the knowledge economy. The engine of growth will be the process through which an economy creates, applies and extracts values from knowledge. The formal school curriculum will always need to balance conflicting pressures; our central challenge is to design one which achieves this balance in conjunction with the learner rather than at the expense of the learner. Placing the curriculum at the core of an open, systems driven approach to reform, offers an opportunity to pursue the former approach (Bentley, 2007).

Innovative modernization of Curriculum in Slovenia

In the last ten years the innovative curriculum is more and more interesting for our teachers and students. In the last three years the number of schools in the innovative project of The National Education Institute of Slovenia has increased for three hundred percent (300%). More on The National Education Institute of Slovenia website: http://www.zrss.si/. This piece of information indicates a strong tendency of withdrawal of the Slovenian schools from classical to innovative curriculum. The needs and contents of modernization show that each project team creates a more efficient pedagogical communication in its own way. Thus we find that more and more practitioners are aware of three pedagogical challenges, transformations of three classical didactical paradigms, namely:

1. innovative transformation of the classical curriculum with innovative open and flexible curriculum,
2. innovative transformation of the classical differentiation (separating) of learning with innovative forms of bringing a student and a teacher closer with the social learning group and
3. innovative transformation of the classical individualization of learning (the learning plan of an individual) with learning and teaching (lessons) where school develops prior knowledge with the so-called personal curriculum (programme) of the individual student and teacher in the social learning group.

The innovative way of modernizing schooling starts from “bottom up” and is getting closer with the one from “top down”. The fusion of both ways of modernization does not bring only school practice closer to the legislator and the theory but to the economy as well, when school solutions check out as worthy innovations for everyday life. The innovative projects are a part o tradition of the pedagogical renovation in Slovenian schools but not optimal for building the so called sustainable knowledge. Namely, up until now innovations from below have been goal oriented into social relations in a class, into education. But politics encourage modernization of the contents of individual disciplines in the curriculum from “top down”. Thus it is searching for the verification of the value of renovation with practitioners and theoreticians, more rarely with pedagogues and economy. With tradition the Slovenian schools nurse renovation of schools from “bottom up”, when it comes to education (social relations) and insist on the renovation of the curriculum from “top down”, more precisely only with renovation of the subject curriculum and curriculum of individual disciplines, often without the cooperation of teachers who educate and economy which uses and at the same time develops top-level realizations of individual disciplines. Unfortunately, these two disciplines of modernization are often consciously, systematically not connected, upgraded. They are often separately treated and evaluated, also rewarded and financed.

According to the fact that we have experiences and evaluations of good and less good renovations, it would be reasonable to logically connect the renovation of education and schooling between each other, unite them into a uniform renovation with the combination from “bottom up” and from “top down”. Along with this, we must not forget about the things that have been left out up until now, not only in education but in schooling as well: to take into consideration pedagogical and methodical realizations of didactic workers and include current top-level realizations of the researchers and performers in economy more into curricular contents.

Fusion of modernization of education (learning, teaching) and education (contents of learning) can be executed in educational institution in a region within school curriculum and curriculum

of execution respectively, which is based on enabling development of the personal curriculum of a student and a teacher in social learning group. When modernizing the so-called multilayer curriculum, the "Babushka" system can be of assistance.

Modernizing with the "Babushka" system

The "Babushka" system is a strategy of implementation of the whole curriculum into practice (Komljanc, 2007c). The system allows mutual activity of modernization directions from "top down" and from "bottom up". The key of success is in the system of babushkas when the first one fits into the next one. What is important is the order of precedence and the beginning of putting babushkas into the bigger one respectively. First implementation needs to start being occupied with self-regulative mechanisms so that the differentiation of lessons can transform into a form of bringing social learning groups closer together. This is followed by transformation of rules into principles. All this is necessary for creating integrative (integrated, holistic) curriculum, which takes its multilayered characteristic into consideration. Only the whole gives us opportunities for effective sustainable or lifelong learning. Each element of the "Babushka" system works as a didactical principle (Komljanc, 2007c):

Self-regulation

Self-regulation, self-control and self-adjustment as well, are encouraged by the so-called holistic method of evaluation in education and schooling. The factor – student is directed to the expected results and to the development of his own achievements. In the learning process this allows a student and a teacher the so-called formative examination of knowledge development – permanent and process monitoring of the student's development, which is based on the student's presentations of what he has learned and on feedback of the teacher and the student himself and others, who have perceived the presentation, with the purpose of "feeding" the so-called near learning in the way – zone of proximal level development, suggested by Vygotsky (1979 in: Komljanc, 2004) or "feedforward" by Torrance (1993 in: Komljanc, 2004). The National Education Institute of Slovenia in research-applicative project entitled Development of didactics in the field of knowledge evaluation): http://www.zrss.si/ developing the possibilities for more self- regulative assessment knowledge. Formative assessment with effective feedback has benefits for learner and teacher. It's raising learner's and teacher's autonomy.

Differentiation as bringing social learning groups closer together

The so-called pedagogy of community, which was in its primary form introduced by Socrates is committed to differentiation as bringing social learning groups closer together. Lesson in this context take into consideration different forms of differentiation but all with the purpose of helping an individual to be able to get closer to the social group and the holistic curriculum at the same time. There were quite a few lectures on pedagogy of community and the ways of differentiation and enrichment of curriculum in 2007 in Slovenia. Renzulli (2007) emphasises organizing opportunities for everybody and everyone instead of separating the students. Frequent explanation is a sign for the need for lesson adjustment. Five principles of adjustment (contents, process, achievement, class, teachers…) are proposed by Tomlinson (the guru of differentiation):

1. Taking diverse understandings into consideration.
2. Perceiving "hunger" of the brain.

3. Offering moderate challenges.
4. Taking a student's ideas and experiences into consideration while teaching.
5. Striving for impartiality and excellence at the same time (Tomlinson, 2005 in Komljanc, 2007a).

Teachers in Slovenia have different projects to improve personal and sensible learning, because this is the most difficult for teachers who still try to teach in classical way.

Principles instead of rules

Rather than using norms, standards and taxonomies more often, it is more sensible to use principles in the development of autonomy as possible methods and forms for achieving innovative results in learning process.

The first principles were without using this term encouraged by Komensky and many educational theorists, including Pestalozzi. Innovative projects define principles of didactic operation with realizations in the form of news and realizations respectively. This holds true also for the developmental-applicative projects, for example of The National Education Institute of Slovenia, which publishes results in the form of didactic principles (principles and mechanisms of operation respectively). Those didactic principles which are useful for school practice improvement multiply and express themselves with the strengthening of modernization from "bottom up" as didactic novelties define themselves with theoretical realizations. This has been shown in at least two cases: The analysis of the applicability of rules on evaluation and assessment has shown that the rules contain too many articles, which teachers do not even remember and that they often restrict a teacher as regards his/her quality execution of knowledge evaluation. Another case are rules on differentiation which in many articles direct a teacher to using external forms of differentiation (separating social groups).
Only when certain approaches are used by most users after assessing them as useful, they can become a standard – rule or norm. In the opposite case, norms can restrict or they are too loose for the challenges of excellence development (high quality). Too much roles are in our legislation, whose aim is to adjust equity but they have more influence on reducing the innovation approaches.

Integrated curriculum

Integrated curriculum is a holistic curriculum and does not contain only parts of it. Such a curriculum logically integrates disciplines among themselves, for example, with problem-resolving classes (solving current problems of life). Integrated curriculum can make a stronger impression on individual's perception, also due to the experience, than in the case when the theory of the whole organism acts against one organ.

Integrated curriculum supports different approaches and dimensions of thinking about the ecology of living in general. A more holistic view of the world can be achieved by a curriculum which allows different forms of combinations, for example with:
1. interlinking of contents, themes, laws, theories, teaching aims, teaching problems, disciplines,
2. methodological approach (methods and theories of teaching) which enables focusing on the essence, core, parts of certain contents,

3. adding contents, aims, subjects, links,
4. crossing contents and aims etc (Lake, 1994, in Komljanc, 2007a).

Integrated curriculum allows different approaches (Lake, 1994, in Komljanc, 2007a), interdisciplinary (referring to several scientific disciplines), thematic and synergic approach (cooperation, supplementing, for example the whole school, blurred boundaries among subjects, orientation towards the process of teaching where all the school subjects are taught as inseparable)… Integrated curriculum includes a combination of subjects, suggests project working method, does not use classical textbooks, searches for links among notions, laws, theories, axioms, organizes thematic units as principles, uses the so-called flexible schedule and combines students into different groups.

Integrated curriculum enables the constructivist model of lessons which appreciates in-depth knowledge of a discipline (subject), holistic model of learning, where there is no pure learning by heart, where connections among notions are looked for, where action learning is executed and where the form of education has progressive (developmental) purpose (Komljanc, 2004). Advantages of integrative curriculum Lipson (1993, v: Lake, 1994, in Komljanc, 2007a) sees in: 1. use of skills in life, 2. encouraging feedback, 3. connecting basic knowledge, 4. in-depth learning, 5. positive atmosphere for learning and 6. research quality of personal curriculum.

Multilayer curriculum

Multilayer curriculum, personal (student's and teacher's), school, local, national and global curriculum and curriculum of performance begins and ends with achieving outcomes of an individual (personal curriculum). It is affected by other levels of curriculum (society in narrower and wider community). School curriculum respectively is effective if it manage to offer a choice to the personal curriculum, student's and teacher's, in the right balance. If local society manages to include itself with its programme in education and schooling, then school is opened to the environment and the surroundings are connected with school: students, parents and teachers.

Slovenian schools usually implement national curriculum. With vision and aims of global curriculum development it wants to affect personal conduct of an individual in the process of education, development of a student's and teacher's personal curriculum. For this purpose schools include themselves into different international projects.

School curriculum includes the programme of life and work of the lessons factor in a school community. It often has two poles. In one pole we find the obligatory curriculum, its standard is prescribed by the state and the other pole, which is freer and in agreement with an individual to a learning group in a learning environment. It is sensible to blur the sharp boundaries of the bipolarity of the curriculum with interlinking – integration. One of the possibilities is described in a booklet entitled Interes zbudi dejavnost (Interest arouses activity), Zavod RS za šolstvo (The National Education Institute of Slovenia) (Komljanc, 2007b). In this manner a student and a teacher can bring personal goals and interest closer to the standard of knowledge in international analyses of knowledge and expected result from the curricula. The holistic school curriculum enables a student and a teacher to be included into learning of school aims personally and achieve goals respectively and helps an individual to solve learning problems. The school curriculum thus sounds like an opportunity for self-development.

School curriculum or the programme of life and work, as we like to call it, is thus alive and current, connected to students and teachers. But it is also connected to the others in the living environment if school aims solve real problems in narrower and wider living environment. In this manner school is useful not only for students but students are useful for the community, which they live in as well, already during schooling. During the school time, learning is thus alive, current and so it raises the amplitude of motivation for active participation and contribution to an individual in a learning group and living environment respectively. Thus school mixes with society and does not remain an artificial place in the environment.
National curriculum is only useful when it fits perfectly to the other layers of the curriculum, the core (personal goals), the programme of school life and work and activities in near surroundings and on the other hand fits the global layer of the curriculum. This is only possible if directives of the national curriculum support the holistic model and the so-called integrated curriculum.

Lifelong learning

The aim of lifelong learning is to attain all the preceding principles: self-development of knowledge, self-regulation of learning and teaching, all the depth and width of realizations, general and specific knowledge, personal open curriculum, ability for the so-called open learning. This means that lifelong learning supports the autonomy of the factors of education up to the point where every factor in a group takes control of its learning. A student develops autonomy in the dimensions of independence, a teacher in the extensions of professional development (personal responsibility, reflection) and parents in the sense of personal and family responsibility for the development of abilities and skills.
Lifelong learning as a form of self-development wishes to bring a person to the level of motivation for building prior knowledge on his own abilities and in contact with others (constructivist model of teaching). The method of teaching will influence the depth of cultural changes, the autonomy of individual's conduct in society. Characteristics of the so-called open learning:

- with its actions it does not harm nor itself or the others neither the nature (physical and emotional safety),
- it freely (flexibly) adjusts to the circumstances and needs and expectations of an individual and a social group,
- it enables opportunities for many abundant experiences,
- it contributes to the reasonable, logical planning of activities,
- it encourages authenticity and credibility,
- it includes reflection for self-awareness, for introspection – for inner conversation to yourself about your talent, interest, wishes,
- it develops empathy to others and
- it includes a student into the action in the surroundings (by Aviram, 2000 in Komljanc, 2007d).

The world is becoming a global open learning environment

The world is becoming a global living environment where distances are nearer than ever, the supply of information is larger than ever and it is still filling up. Connections among continents, people are getting better and better. Some differences of living are decreasing, and some are strengthening. The tendency is to accept the culture of others, but we can accept the

other, the different one, if we are able to get to know him (perceive his life and language, communication). Education in this sense is gaining on its value and not just on formal level (Komljanc, 2007c).

Self-regulation of learning and teaching (lessons) puts a great emphasis on mutual feedback in constant formative monitoring. Differentiation as bringing social learning groups closer together brings a student and a teacher together with the curriculum, thus we help an individual with self-development in a social group. It is easier to perform pedagogic communication flow capacity but above all ideas develop faster into creative products if frequent school rules are transformed into pedagogic principles for achieving or exceeding school standards.

Integrated curriculum connects disciplines for solving learning and life problems respectively considering technological changes in mutual communication and culture of a living environment respectively. The ecology of living includes a person in a community, his education and dialogue, also with himself. This is the key element for forming opportunities of sustainable development.

Multilayer curriculum, which includes personal, school – curriculum of performance, local, national and global curriculum, contributes to solving current life problems and challenges respectively in accordance with expectations and prior knowledge of a teacher and a student. Indicators for quality permanent knowledge and thus lifelong learning are: self-development, self-regulation of learning, depth and width of realizations, general and specific knowledge, personal open curriculum and ability for the so-called open learning.

Innovative projects in Slovenia – some examples

Some innovative projects are designed for developing advanced competencies and the knowledge and skills necessary to understand relationships between school curriculum, industrial management and technology innovation. Teacher's style and method of teaching are the key factor for open learning environment. Both influenced on dialogue with the student and on the choice or selection of the learning and teaching sources.
Some examples:

High school Idrija, leader of the project is Karmen Vidmar. The aim of the project is to promote the interest for science and technology. The school is connected with company named "Colector" (they produce electricity powered motors). Students used their laboratory for research of their expected outcomes. The benefits after one year are: more than a half of them are more interested in science and technology, some of them got scholarship, and they reached higher achievement. They can do some experiments, which could not be made in school because they do not have the appropriate and expensive equipment, but Colector has.

Postojna cave set a net of schools witch are interested in geographic and geologic research. They also work in broader framework of sustainability. The programme for promotions was enriched by students' and researchers' achievements. Students follow up the integration curriculum. In net schools inform each other about their performance and also achievements. Students also help as guides by presenting the sights to foreign tourists. They also prepare different material for advertising. In that way students promote Postojna cave and surroundings all over the world, not just in Slovenia. They also have very interesting open

learning environment for project work in all lifelong periods. The company got some financial support in return.

Sitarjevec mine in Litija has just launched huge and important environmental open learning project. To sustain an old abandoned mine, the Research Centre in Litija along with the help of universities and schools and NEIS. They promote the project by preparing an open learning programme for learning in mine for pupils and students and also for adult researchers. The project is focused on the restoration of the mine and at the same time on its promotion and the promotion of its surroundings. Universities in Slovenia and Czech and also NEIS are connected with the region. The local government came to the important conclusion that it should be more concerned the restoration of the mine, which already represents a thread to the surroundings because of the big amount of accumulated water in the mine.

Facilitate support an open learning environment

In 2008, NEIS invited students, teachers and parents to the promotion of open learning environment. We have assisted to very interesting performance of different schools and amazing ideas of students. We got not much but intersting performace from schools and very intersted ideas from students. All proposals are closely connected with everyday life in care for a better cooperation with the society.

In ENSI project named Innovative Learning Environment we will try to find the answers for the following questions:

1. What kind of learning environments an innovative society needs?
2. Which are key factors for real open learning environment?
3. Where to start with redesigning the classical school environment?
4. How to facilitate supportive learning climate?
5. Why has a learning environment influence on student's achievement?

The answers will be a part of recommendations for our schools so they can develop the conditions for innovative learning environment in the near future.

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KNOWLEDEGE MANAGEMENT IMPLEMENTATION IN MULTINATIONAL COMPANIES – AN EMPIRICAL STUDY IN MALAYSIAN MNCs

Tan Nya Ling[1], Robert J. Nathan[2]
Faculty of Business & Law, Multimedia University,
Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia
nltan@mmu.edu.my[1], Robert.Jeyakumar@mmu.edu.my[2]

ABSTRACT

With the emergence of knowledge management (KM) that has become one of the growing interests in today's business, it is seen that the number of organisations turning to KM is increasing tremendously. Therefore, with the importance of KM being realised, businesses in Malaysia especially multinational companies (MNCs) are viewing critical success factors (CSF) and KM processes seriously in fulfilling their needs to improve their overall organisational performance. This study attempts to investigate whether a knowledge management programme benefits MNCs operating in Malaysia. Based on the outcome of the literature review, CSFs is found to have an impact on successful KM implementation. It also identifies systematic KM processes that provide a clear guideline for interested MNCs in creating, gathering, organising, diffusing, and using precious knowledge that is available. The advantages of KM implementation were measured based on financial and non-financial measurement. The research findings provide useful information for MNCs in guiding their KM implementation efforts. Through such information, MNCs can identify important areas which need more attention and focus.

Keywords: Knowledge management implementation; critical success factors; KM processes; organisational performance; multinational companies

INTRODUCTION

In a global competitive market, KM adoption among companies at an early stage is seen to further enhance competitive advantage compared with companies which do not adopt it. Consequently, as stated by Chong, Chong, & Yeow [10], various empirical and theoretical evidences have proven KM to be a key source of competitive advantage and subsequently leading to organisational success. In the current knowledge-based economy, knowledge resources are considered as the most crucial and complicated resource to be managed in a competitive environment [26]. With more competitors entering the marketplace, companies have to fully utilise their knowledge resources in order to become business leaders in a particular industry. KM helps organisations in developing synergies between disparate knowledge objects resulting in an increased on innovations [11]. As such, KM has become the only solution for organisations, big or small, local or multinational to be at the forefront of business success.

Recent survey evidences have shown that, while many organisations are claiming to have implemented KM, not many of them are considered to be successful in their KM efforts [7, 8]. In view of this, organisations need to incorporate a set of capabilities and competences to further maximise the utilisation of knowledge which in turn can be leveraged to generate new knowledge [26]. This also applies to the multinational companies (MNCs) as Gupta &

Govindarian [14] explains that MNCs need proper understanding of its ability to transfer and exploit knowledge more efficiently in the corporate context.
This study aims to examine the impact of Critical Success Factors (CSFs) i.e; training, employee involvement, teamwork, empowerment, leadership commitment, Information System infrastructure, performance measurement, knowledge-friendly culture, benchmarking, knowledge structure, organisational constraints, business strategy; and KM processes i.e; knowledge creation, knowledge gathering, knowledge organising, knowledge diffusing, and knowledge using; on the performance outcome of organisations. The result of this study will be helpful to MNCs, serving as a guideline in identifying important factors and processes in KM implementation within the organisation.

LITERATURE REVIEW

Knowledge and Knowledge Management (KM)

According to Walczak [36], knowledge is any data, skill, context, or information that enables high quality decision-making and problem solving to occur. For that reason, knowledge should be conceptualised in a way that allows better quality and lower cost through product and process innovations, thus contributing to better business performance [1]. Leaders from diverse organisations are pursuing numerous ways to create and generate value from knowledge assets within their organisations.

Knowledge is intangible and surfaces in a variety of forms [29]. Generally, knowledge can be divided into two major categories, namely tacit knowledge and explicit knowledge. Both tacit and explicit knowledge are the intangible assets of an organisation as it can transform from one form to another in an organisation [23]. Explicit knowledge is knowledge articulated and codified in handbooks, computer programmes, databases, and training tools, and among other elements, this knowledge is transmissible [26].

On the other hand, certain resources based on knowledge such as skills, competencies, capacities, know-how, technology and experience, cannot be completely reduced to codified knowledge [26]. Subsequently, tacit knowledge is personal, context specific and difficult to regularise. It includes cognitive elements that are ‘mental patterns’ that help individuals to perceive and define their environment. Nonaka [23] defines tacit knowledge as knowledge that is internal to a person, such as cognitive learning, mental models, and technical skills

Various researchers and practitioners have different perspectives on the concepts of knowledge that lead to different definitions of KM. As a result, it is not surprising that the expected outcomes of KM efforts are defined differently [8]. Based on a studies conducted by Chen & Hsiang [26], it is found that KM are extremely beneficial to the growth of an organisation as a whole.

KM Critical Success Factors (CSFs)

CSFs create an important meaning to KM through the identification of core processes that are critical to successful KM implementation [28]. There are twelve critical success factors identified by various researchers, which includes: (1) training, (2) employee involvement, (3) teamwork, (4) empowerment, (5) leadership commitment, (6) Information System (IS)

infrastructure, (7) performance measurement, (8) knowledge-friendly culture, (9) benchmarking, (10) knowledge structure, (11) organisational constraints, and (12) business strategy. These CSFs are briefly described and discussed in the following paragraphs.
Training is important in an organizing enforcing continuous learning culture to prepare workers with the skills that foster creativity, innovation, and knowledge sharing. According to Salleh & Goh [30], in order to become a true knowledge-based organisation, companies must start with quality training.

Employee involvement is seen as an important factor for successful KM implementation. It explains how employees can contribute effectively without the need for close supervision. Employee involvement and commitment are to be heavily emphasised in KM implementation since employees are the ones involved in the very nature of knowledge creation and sharing [9].

Knowledge organisation is composed of knowledge groups that are consists of knowledge teams, which are built from knowledge workers selected for participation on a knowledge team due to their tacit knowledge and skills [36]. Teamwork, therefore allows knowledge transfer within organisation where this is not encouraged under the traditional hierarchy management structure. Teamwork is vital in KM implementation as team workers that comes from different departments contain diverse skill and experience in problem solving.

Empowerment is the process of displacing decision making downwards to the workforce or lower levels of management, enabling them to use their skills more effectively and flexibly. Empowering and involving managerial practices increase the need to trust workers to carry out critical organisational task without close and frequent supervision. As a result, it allows them the autonomy to deal directly with customers [8]. Through empowerment, employers can value their employees' expertise and help them communicate their knowledge by creating ways to capture, organise and share knowledge [20].

Leadership commitment plays a vital role in ensuring the success of KM project, particularly in knowledge creating and culture sharing activities and that the ultimate key to organisations successfully embracing sustainability is leadership [11, 21, 27, 37]. Without good leadership commitment, it would be impossible for organisations to implement KM systems in their organisation. Leaders should demonstrate good behaviours and actions in order to influence their employees to participate in KM activities such as knowledge sharing, continuous learning, and seeking new knowledge.

IS infrastructure is another important factor for KM implementation. IS infrastructure is the development and implementation of KM by adopting new and more advanced technologies infrastructure [7]. The realities of global IS infrastructure make it necessary for organisations to play a proactive role in leading and transforming their organisations into a knowledge-based economy [9]. Good IS infrastructure in believed to help organisation to manage knowledge process, support ad-hoc workflows, establish task and project management, and build and navigate process-oriented knowledge element [19].

Performance measurement is related to the key areas of the organisation such as expansion, innovation and productivity, which is critical to the development of prosperity of an organisation [5]. Many researchers have found a positive relationship between performance

measurement and successful KM implementation [1, 4, 5, 35]. A good performance measurement system is especially important for MNCs where the intellectual capital of the employees is critical to the success of the organisations [8].

Knowledge-friendly culture can facilitate faster learning. Certain organisational culture support and facilitate knowledge transfer whereas other cultures promote knowledge retention [26]. Chua & Lam [11] opined that unless an organisation instils a knowledge sharing culture, KM implementation is unlikely to succeed.

Benchmarking has been one of the most effective tools for developing and improving KM as it is not limited just for process improvement or reuse. It plays an important role in implementing KM and in gaining competitive advantage [7]. It measures the organisations' performance towards its strategic goals, its overall productivity, service quality, customer satisfaction, costs, profits and margins, distribution and relationships management.

Knowledge structure is also identified as one of the CSFs for successful KM implementation [15]. The knowledge infrastructure is part of the overall organisational structure and it is important that this organisational structure facilitates KM practices [2].

Organisational constraints are a barrier to successful KM implementation. KM implementation may not be achievable if organisations cannot eliminate organisational constraints that are present in an organisation [11]. Therefore, it is imperative for top managers to ensure that all constraints are removed as it may lead to organisational inefficiency, ineffectiveness and powerlessness.

Business strategy is also considered as the most important and most implemented factor. The results make sense as objective is normally the first step towards a successful KM program [22]. Top managers should ensure the consistency between the organisation's mission and knowledge strategy by clearly defining knowledge goals that are connected with functional strategies [18].

KM Processes

Systematic KM process provides a clear guideline for organisations in the KM implementation process, which includes: 1) knowledge creation, 2) knowledge gathering, 3) knowledge organising, 4) knowledge diffusing, and 5) knowledge using.

Knowledge creation involves developing new knowledge or replacing existing knowledge with new content [24]. According to Nonaka, there are four kinds of knowledge creation, which are socialisation i.e. conversion of tacit knowledge to new tacit knowledge through social interactions and shared experiences; externalisation i.e. converting tacit knowledge to new explicit knowledge; combination i.e. creating new explicit knowledge by merging, categorising, and synthesising existing explicit knowledge; and internalisation i.e. creating new tacit knowledge from explicit knowledge [24, 25].

Knowledge gathering is frequently the most mundane, most boring, least understood, and consequently the most ignored aspect of KM [33]. However, systematic gathering of information on customers and competitors is very important [1]. It is stressed that every

organisation needs to identify where knowledge resides in the organisation [3, 34] as to facilitate the immediate searching, identification and learning of potentially valuable knowledge.

Knowledge organising is challenge for today's managers due to the tedious process of filtering and extracting relevant knowledge from the vast amounts of potential and actual information available from internal and external sources. Knowledge has to be structured in a format that is meaningful to the task at hand or is digestible to KM. The knowledge is to be gathered from different groups of knowledge worker and therefore it has to be arranged accordingly for easy access, thus the knowledge concerned "…becomes a part of the organisation's memory" [17, p. 168].

Knowledge diffusing helps to describe how to find, what to find, and where to find useful knowledge within the organisation [32]. The organisation's head had to share it, or make certain that it was transferred to the appropriate knowledge workers, or those who would be affected by it [33]. Thus, in order for knowledge to have wide organisational impact, it must be diffused throughout the entire organisation [16].

Knowledge using is the systematic use of knowledge that will guide strategy recognition, understanding, creation, selection, implementation, and modification of products and services [1]. Once knowledge is diffused, it may be use [17] in facilitating innovation, collective learning, individual learning, and/or collaborative problem solving [16].

RESEARCH METHODOLOGY

This study identified one dependent variable i.e. organisational performance; and two independent variables i.e. KM CSFs and KM processes to be tested. Figure 1 shows the conceptual framework of this study.

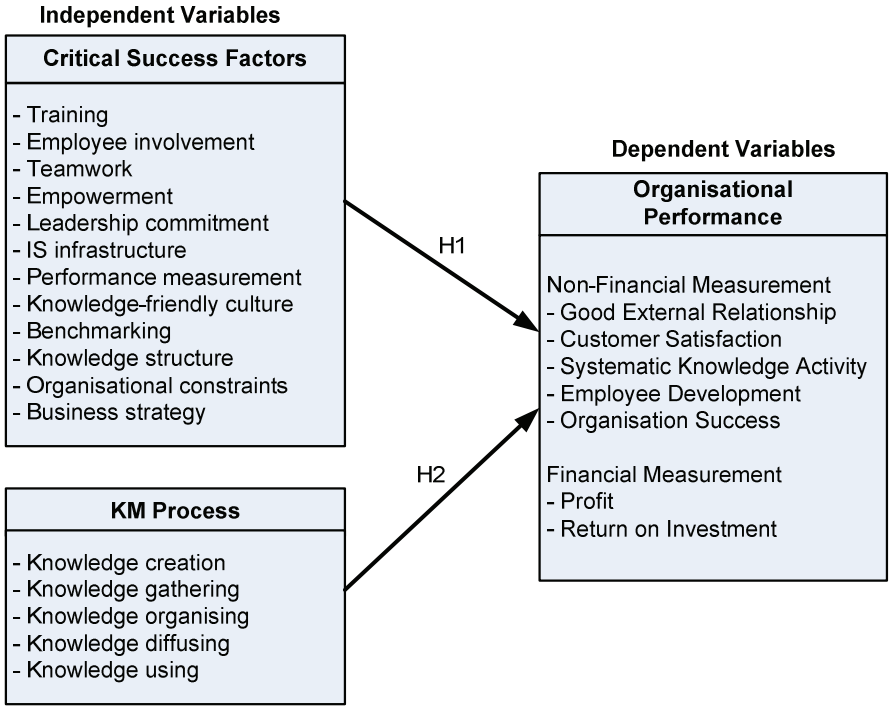

Fig. 1: Research Conceptual Framework

A questionnaire was used as the research instrument to collect the needed data for the study. The questionnaire is divided into four sections. Section A contains information on individual and organisational demographic characteristics. Section B covers the degree of implementation of KM (independent variables) in which a five-point Likert scale (not implemented to extensively implemented). Each variable is measured through 4 to 5 statements each. In Section C, KM processes in MNCs are measures, which include knowledge generating, knowledge gathering, knowledge storing, knowledge distributing, and knowledge using. Similarly, each KM process variables are measured through 4 to 5 statements in the questionnaire. These items are adapted from Syed-Ikhsan & Rowland [34]. Finally, Section D measures the KM performance outcomes. In this section, the respondents were asked to rank the impact of KM on the performance on their company using a five-point Likert scale (no value to high value).

MNCs from more than 40 countries have invested in over 3,000 projects in Malaysia. The respondents selected to participate in this study are managers and above from MNCs operating in Malaysia. A comprehensive company name list of all MNCs operating in Malaysia was obtained from Malaysian Industrial Development Authority (MIDA). The study aimed to collect 300 samples for data analysis using its available resources through systematic sampling using skip method from the master name list of companies. Since the data collection was done via mail, the authors decided to select about 1000 companies from the company name list. One thousand questionnaire was sent out with self-addressed envelops included in the questionnaire package.

RESULTS AND DISCUSSION

From 1000 questionnaires that were sent out, only 102 questionnaires were returned, which is about 10% response rate.

From the received respondents, 19 of the managers are female while 83 are males. It does indicate that males largely dominate the leadership positions in MNCs investing in Malaysia.

The managers who participated in the study came from various departments of MNCs, as shows in Figure 2. Besides those who indicated "others", the largest group of respondents came from Finance departments (19.61), followed by Marketing / Sales (17.65%) and Human Resource department (16.67%). There's very small representation from Research & Development and Production departments (1.96%).

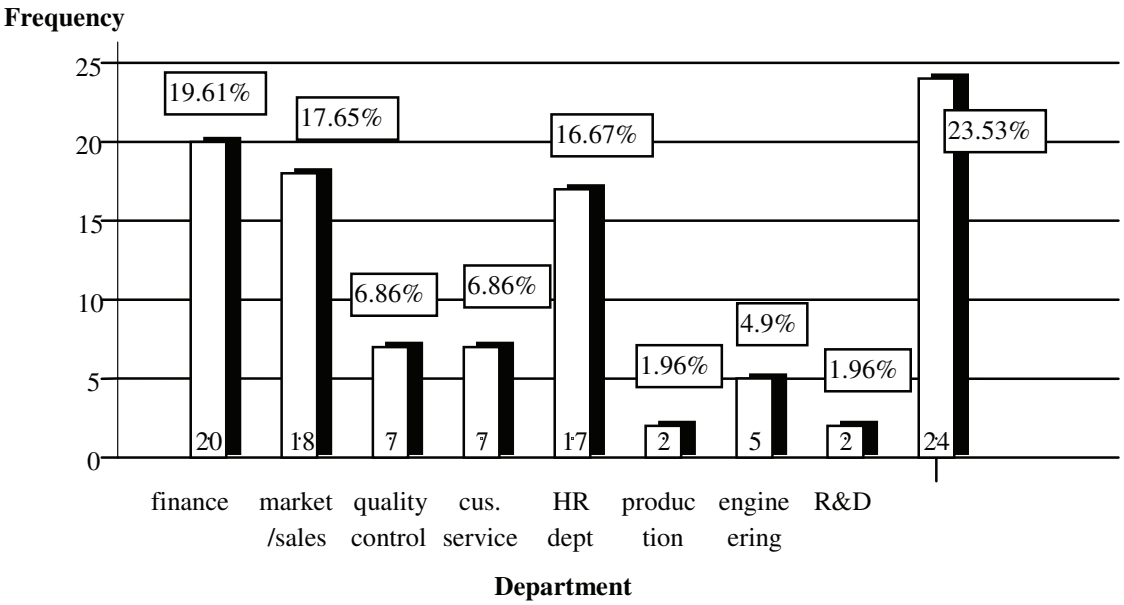

Fig. 2: MNC Managers from various departments in company

Reliability analyses were conducted on the independent and dependent variables. Result yield Cronbach Alpha value of 0.829, which can be regarded as reliable for further analysis [31].

Table 1 shows the means and standard deviations of the CSFs, KM processes, and financial and non-financial measurement.

Table 1: Summary table showing means and standard deviations of CSFs, KM processes, and financial measurements

CSFs			
No.		**Mean**	**Std. Dev.**
1.	Training	3.04	1.089
2.	Employee involvement	3.37	0.843
3.	Teamwork	3.72	0.763
4.	Empowerment	3.35	1.011
5.	Leadership commitment	3.58	0.789
6.	IS infrastructure	3.54	0.852
7.	Performance measurement	3.46	0.897
8.	Knowledge-friendly Culture	3.64	0.806
9.	Benchmarking	2.8	0.758
10.	Knowledge structure	3.62	0.797
11.	Organisational constraints	3.21	0.813
12.	Business strategy	3.13	0.897
KM Processes			
1.	Knowledge creation	3.95	0.50
2.	Knowledge gathering	3.71	0.77
3.	Knowledge organising	4.14	0.77
4.	Knowledge diffusing	3.79	0.55
5.	Knowledge using	3.86	0.83
Non-Financial Measurement			
1.	Good external relationship	4.11	0.88
2.	Customer satisfaction	3.86	0.75
3.	Systematic knowledge activity	3.87	0.73
4.	Employee development	4.20	0.60
5.	Organisation success	3.86	0.61
Financial Measurement			
1.	Profit	4.08	0.68
2.	Return on investment	3.86	0.76

Among all the variables tested in this study, MNC managers have rated Teamwork the highest with mean (3.72). This shows that tasks performed in team can yield better performance than working individually. Teamwork enhances performance as members in team can cooperate with others with different skill-sets and knowledge. This study found Teamwork to be the most important factor that affects KM implementation in MNCs. From Nonaka's SECI model, socialisation seems to express teamwork the best [24, 25]. Teamwork emphasises socialisation among individuals in teams in working to achieve a common goal. MNCs seem to emphasise Teamwork in their organisation in their quest to improve the social interaction and knowledge management implementation in their organisations.

The overall mean and standard deviations score for KM processes is 3.89 and 0.68. Majority of the respondents state that knowledge organising is the most effective process that had been implemented (4.14). Most managers are aware of the importance of knowledge. Therefore, they pay attention to storing all important organizational knowledge that they have gathered.

The overall mean and standard deviations score for the non-financial variable is 3.98 and 0.71. Most participants agree that employee development is the most important measurement for KM (4.2). Companies face problems when employees leave an organisation and bring all valuable knowledge and experience with them. Company can solved the problem by storing all known knowledge in a KM system. Therefore, organisation tends to evaluate KM effectiveness using employee development. On the other hand, the mean of both customer satisfaction and organisation success are low, which is 3.86. It shows that organisation might not be aware of the improvement of customer satisfaction and organisation success that result from KM implementation. Furthermore, as most organisations are just starting to implement KM, the result might not significantly influence customer satisfaction and organisation success.

The overall mean and standard deviation for financial measurement is 4.08 and 0.68. This shows that most organisations are focused on using profit or short-term monetary gains to evaluate the performance. This might be due to the reason that the return on investment might take a longer time for evaluation. Therefore, managers tend to use short term parameters to measure the effectiveness of KM.

The followings two hypotheses were tested in this study using One-way Analysis of Variance (ANOVA), to test the significant effect of CSFs and KM Process towards Organizational Performance. Table 2 is shows the summary of the results obtained through statistical analysis. Result shows that CSFs significantly affect the Financial Performance of MNCs. KM Process on the other hand significantly affects both the Financial and Non-Financial Performance of MNCs.

Table 2: Summary of ANOVA test results from Hypotheses Testing

Hypothesis	Independent Variables	Dependent Variable (Organizational Performance)	
		Financial	Non-Financial
H1	KM Critical Success Factors	F = 2.203 p = 0.018 Significant	F = 1.785 p = 0.063 Not Significant
H2	KM Process	F = 4.746 p < 0.001 Significant	F = 12.136 p < 0.001 Significant

LIMITATIONS OF STUDY AND FUTURE RESEARCH

The study only obtained 102 respondents which may not accurately represent all the MNCs in Malaysia. Due to the limitation of words for this conference paper, this paper only discussed briefly the main findings of the study.

Future studies could get more representative sample of more MNCs as well as MNCs from East Malaysia as they are not represented in this study. Studies could also analyse the effect of KM implementation in different functional departments in the organization.

Future study may identify more critical success factors such as organisation structure to examine its effect to KM implementation. Studies have suggested that the increasing competition and ever shortening rates of technological change necessitate better transfer of knowledge across organisational boundaries [13]. Hence, organizational structure could be an interested factor to be studied in relation to KM implementation in organizations.

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A STUDY FOR THE DETERMINANTS OF CUSTOMER LOYALTY PERSPECTIVE IN E-RETAILING

Dr. Bruce C. T. Ho, Faye H. J. Chen
Institute of electronic commerce, National Chung-Hsing University, Taiwan
cutey0104@gmail.com

ABSTRACT

E-retailing is no longer just a place for bargain hunting and information exchanging for customers. Moreover, it is increasingly being viewed to provide better service and enhanced customer relationships. Thus, the main purpose of this research is to stand on an integration perspective to combine web quality, user belief, i.e. perceived ease of use (PEOU) and usefulness (PU), trust, customer satisfaction and loyalty in order to see if there were any interaction or effect important to customer's purchasing behaviors.

A survey of 728 users of Taiwan's biggest bulletin board system (BBS) –"E-shopping billboard" is conducted to test our model, and the response rate is about 95.6%.

The results of this research find that Web quality, categorized into system, information, and service quality, have a significant impact on the PEOU, PU and trust; thus, it encourages website use in the context of online retailing. Also, we investigate that the relationships among PEOU, PU, trust, customer satisfaction and loyalty are all positive and highly relevant. Our study thus provide a balanced and integrated framework for determining Web quality and traditional CRM main constructs which should help Web practitioners and researchers better understand user behavior in e-retailing.

Keywords: CRM, customer loyalty, web quality, e-retailing, SEM

INTRODUCTION

Research Background and Motivation

Customer loyalty is increasingly being viewed by businesses as a way for keeping long-term business profitability. Some business analysts have recommended that the cost of recruiting a new customer is five times more than the cost of retaining an existing one [73]. Moreover, in understanding customer loyalty, prior studies have discussed about customer satisfaction [42], switching barrier [42], alternative attractiveness [42], service quality [19], trust [37,48], and habit [48]. Given this evidence, it is obvious to see that companies are rushing to implement loyalty programs and eager to know if there were key determinants for customer loyalty.

Nevertheless, these factors affect customer loyalty directly and significantly in electronic commerce (EC) area, but these studies didn't conduct website perspective and also the customer's (website system users) affective reactions toward website.

E-retailing is no longer just a place for bargain hunting and information exchanging for customers. Moreover, it is increasingly being viewed to provide better service and enhanced customer relationships. Nevertheless, without the physical contact with the customers, how e-retailers to measure their customer relationship management (CRM) performance becomes a key dimension to obtain customers' loyalty, and further to achieve the business success.

As more and more retailers started up their business online and techniques related to Internet grew rapidly, shopping website is getting much more mature nowadays regardless of system design, information richness, and service quality. Thus, e-retailers not only do their business but need to maintain their websites, i.e. functions design, safety mechanism, service delivery, information collected, but for customers as well as website system users, these functions, information, or service may not fit what they really want or need for purchasing decision. In addition, although there are lots of prior studies [1,9,19,37,42,48] raising some key dimensions for enhancing e-retailers' CRM performance, few of them conducted website-related dimensions with traditional CRM framework; as a result, how this relationship is developed based on the customer's (website system users) affective reactions of the website is a missing block of our knowledge.

This research, therefore, presents an investigation of an integrated framework of customer loyalty by identifying the key determinants and examining their differentiated effects among each other, and finally, to inspect fitness of the framework we posed.

Research Objectives

Based on the arguments discussed above, the main objective of this research is to determine the factors which will affect customer loyalty performance of e-retailers in Taiwan. In addition, the results of this study also provide basic guidelines for newcomers developing their website and starting up business without failures or problems. Accordingly, the objectives and scopes of this study is to stand on an integration perspective to combine web quality, user belief, i.e. PEOU and PU, trust, customer satisfaction and loyalty in order to see if there were any interaction or effect important to customer's purchasing behaviors. Also, testing the model we pose to see the applicability in Taiwan's e-retailing. All data of this study were collected from customers who had the experience on shopping in e-retailers, and analyses of this study were conducted using structural equation modeling (SEM) via AMOS.

LITERATURE REVIEW

Previous studies have indicated that there are lots of factors influencing customer loyalty

performance, such as customer satisfaction [42], switching barrier [42], alternative attractiveness [42], service quality [19], trust [37,48], and habit [48]. However, these perspectives have just been examined independently. Thus, in this research, we try to explore more detailed information to figure out the impacts on the customer loyalty performance and integrate these perspectives and empirically examining the factors.

The model of this research is integrated from three previous studies. All of these studies are base on the original TAM [18]. Figure 1 shows the research model which integrates these three above-mentioned studies.

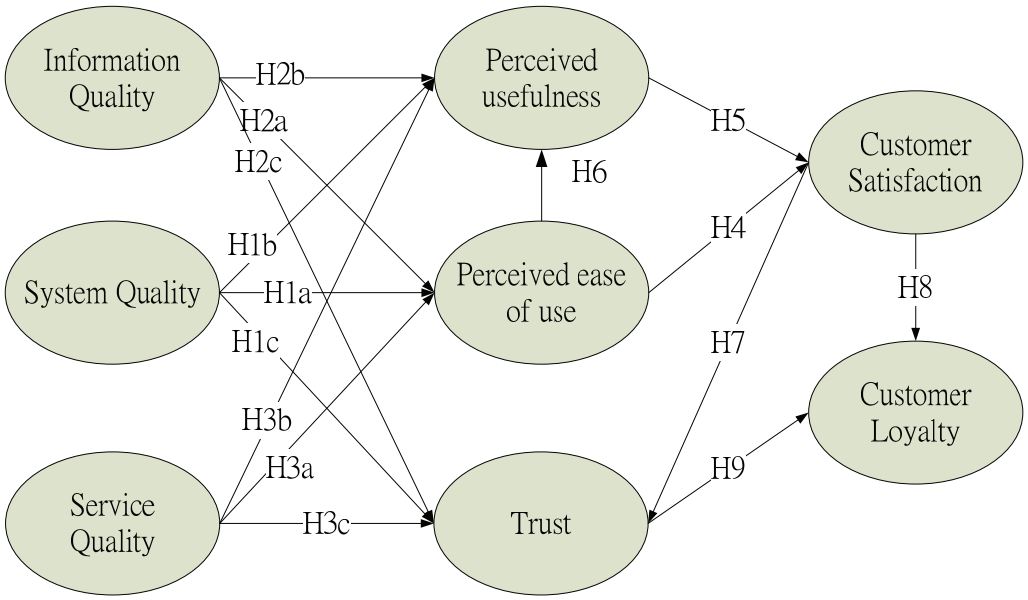

Figure 1. Research model

Web quality

Many studies have explored the relationship between Web quality and user acceptance in the Web context because the quality of the Website affects the user view of the site and it is the portal through which the transactions are conducted. Most of them showed that Web quality had a positive impact on user belief of perceived usefulness and perceived ease of use. Although they showed that some quality factors had a positive effect on site acceptance, few took service quality into consideration. Shih [79] demonstrated that service quality significantly determined consumer willingness to use online retailing.

As a result, in this research we define Web quality with service content as the user's perception on the usefulness and ease of use based on the website interface and functions. We claim that Web quality with service contents of self-service technologies, such as an e-commerce website, can positively influence a consumer's perception of using the system and shopping behavior [17,41,69]. Liang and Lai [83] found that the quality of e-store design has an effect on the customer purchase decision. Swan and Rosenbaum [50] found that there are features of a website's interface that play a role in the social construction of trust as

people explore a website.

System quality

System quality refers to the processing characteristics of a website. It is a fundamental element in user's perception on the usefulness and ease of use and also its security mechanism influences user's trust with a web purchase: appearance, technical adequacy, delay, navigation, security, and privacy are important factors.

High level of system quality may provide users with more convenience, privacy, and faster responses. Lederer, Maupin, Sena, and Zhuang [45] and Liao and Cheung [86] showed that such system capabilities had a positive impact on perceived ease of use and usefulness of Website. Koufaris [43] showed that the use of value-added search mechanisms could make the shopping experience more fulfilling and enjoyable. Hwang and Kim [37] showed that the perceived system quality has influence on e-trust, mediated by the website user's affective variables. Therefore, by breaking user belief into perceived ease of use and usefulness, we hypothesize the following.

H1a. System quality has a positive effect on the user's perceived ease of use of online retailing.

H1b. System quality has a positive effect on the user's perceived usefulness of online retailing.

H1c. System quality has a positive effect on the user's trust of online retailing.

Information quality

Information quality is considered to be the output quality of IS, and then used it to represent information characteristics, usually determined at the system design and development phase. For example, Bailey and Pearson [38] developed scales for measuring IS satisfaction, including accuracy, precision, currency, timeliness, etc., to evaluate information quality. Previous studies frequently used information quality to measure IS performance [12,76,81]. Information quality is included in an assessment of the effect of Web use, especially on searching products/services in e-shopping. During e-shopping transactions, both consumers and firms communicate and coordinate by exchanging and sharing information via the Internet. Thus, information quality is assessed using consumer perceptions of the quality of information on the Web.

Studies have shown that information quality has a positive impact on perceived ease of use and usefulness of a Website. Lederer *et al.* [45] found that information quality had a significant relationship with perceived usefulness. Jarvenpaa and Todd [40] showed that

positive comments from customers were related to the clarity and visual appeal of information on a product, service, or shop. Koufaris [43] showed that more enriched and satisfying shopping information could be interesting and helpful. High levels of information quality (various, complete, detailed, accurate, timely, relevant, and reliable) were also likely to provide users with convenience, enhanced enjoyment, and better purchase decisions. McKnight, Choudhury, & Kacmar [34] found that web site quality and reputation, are powerful levers that vendors can use to build consumer trust, in order to overcome the negative perceptions people often have about the safety of the web environment. Consumer disposition to trust, reputation, privacy concerns, security concerns, the information quality of the Website, and the company's reputation, have strong effects on Internet consumers' trust in the Website. Thus, by breaking user belief into perceived ease of use and usefulness, we propose the following hypotheses.

H2a. Information quality has a positive effect on the user's perceived ease of use of online retailing.

H2b. Information quality has a positive effect on the user's perceived usefulness of online retailing.

H2c. Information quality has a positive effect on the user's trust of online retailing.

Service quality

Parasuraman, Zeithaml, and Berry [66] developed a 45-item instrument, namely SERVQUAL, to measure service quality in terms of tangibles, reliability, responsiveness, assurance and empathy, to assess customer expectations and perceptions of quality of service from both service and retailing organizations. They also argued that there is a danger that IS researchers will incorrectly measure IS effectiveness if they do not include a measure of IS service quality in their package. Their empirical results have shown that service quality is a determinant of IS success. According to Jarvenpaa and Todd's [40] survey, many consumers said that they were dissatisfied with the quality of service provided by estores. Moreover, service quality was found to determine consumer willingness to e-shop [46]. When consumers initially access websites to search for products or services, service quality perceptions of websites may encourage or discourage them to make a purchase via the Web.

In the Web environment, the service concept should be extended from IS support for internal users to company support for external users. Barnes and Vidgen [3] applied SERVQUAL and IS SERVQUAL of Pitt *et al.*[68] and built WEBQUAL, a measure composed of 10 dimensions: aesthetics, navigation, reliability, competence, responsiveness, access, credibility, security, communication, and understanding the individual. It seems to provide an integrative concept and viable measures of service qualities for e-commerce site. However, there is still a

need to consider other values of service from the consumer's viewpoint. Service quality is likely to be more important for online retailing, because it should provide all the services in the purchasing process (finding, ordering, and delivering the products). A few studies have explored service quality as success factors of Websites, but there are fewer that have tested the relationship between service quality and technology acceptance behaviors.

According to some other writers, however, most of these studies have been identified as specific dimensions of the broader notion of service quality. Reputation, for example, which Ganesan [27] identified to influence the trustworthiness of the vendor, may easily fit with Gronroos' [31] perception of service quality at corporate level. The non-task-related abilities identified by Moorman, Deshpande, and Zaltman [57] fit the conceptualization of service quality at service provision level suggested by Parasuraman, Zeithaml, and Berry, [65]. Moreover, the lack of opportunistic behavioral suggested by Morgan and Hunt [58] corresponds to the notion of reliability in Parasuraman *et al.*'s [65] model of service quality. Thus, we posit the following hypotheses by breaking user belief into perceived ease of use and usefulness.

H3a. Service quality has a positive effect on the user's perceived ease of use of online retailing.

H3b. Service quality has a positive effect on the user's perceived usefulness of online retailing.

H3c. Service quality has a positive effect on the user's trust of online retailing.

Perceived ease of use and usefulness

TAM is a widely referenced theoretical model for predicting intention to use and acceptance of information systems by individuals. It proposes that perceived ease of use (PEOU) and perceived usefulness (PU) determine the attitude toward an information system (IS). The attitude, in turn, leads to one's intention to use an IS and the eventual acceptance of the IS technology [49,56,85]. Recent findings suggest that customer satisfaction in the online environment is significantly higher than traditional channels due to the ease of use in acquiring information [78]. Ease of use can also affect the transaction costs when the ease of use pertains to information search. Utilizing the Theory of Planned Behavior (TPB), a foundation of TAM, Bhattacherjee [5] examined the motivations underlying individual acceptance of B2C EC services. Another TPB-based study found that behavioral costs and intentions significantly influenced online shopping behavior [47]. While TPB explains the system use by incorporating subjective norms and perceived behavioral control with attitude toward using technology, TAM is better suited to EC because it helps to understand the technology acceptance based on ease of use and usefulness. Thus, based on recent research in

EC, we apply TAM constructs to examine consumer satisfaction with the online channel and propose the following hypothesis.

H4. Perceived ease of use has a positive effect on the customer satisfaction of online retailing.

H5. Perceived usefulness has a positive effect on the customer satisfaction of online retailing.

H6. Perceived ease of use has a positive effect on perceived usefulness of online retailing.

Customer Satisfaction

Satisfaction is a consumer's purchase perception of the difference between the expected and received value of a transaction [62]. Also, it is used to measure an organization's "total product" performance related to a set of customer requirements [35]. It is believed to mediate consumer learning according to prior experience and to explain key purchase behaviors, such as complaining, repurchase intentions, word-of-mouth recommendations, trust, or loyalty [23]. Szymanski and Hise [82] concluded that convenience, site design, and financial security are the dominant factors in online consumer satisfaction. Muylle, Moenaert and Despontin [59] discussed Website design dimensions of satisfaction, which has been widely used to predict behavioral intentions. Olsen [64] claimed that relationships between quality and repurchase loyalty are actually based on continuous satisfaction. It also plays an important role in the formation of trust [14]. As a result, we hypothesize the following.

H7. Customer satisfaction has a positive effect on trust of online retailing.

H8. Customer satisfaction has a positive effect on customer loyalty of online retailing.

Trust

Recently, issues related to security, privacy and customer protection become much more important to the e-commerce and e-retailing area. These all can be reduced to consumers' lack of trust in e-retailing [16,22,36,53]. Moreover, trust can enhance customer loyalty on repurchasing [28,58]. Also, Chiou [11] found that perceived trust had direct and positive impacts on customer loyalty. Therefore, only if the consumer trusts the retailer will he or she feel comfortable when purchasing a product, giving personal information, and using payment methods other than cash. In brief, without consumer trust, e-retailing will never reach its full economic potential [24]. According to prior studies, trust is defined as a group of beliefs held by a person derived from his or her perceptions about certain attributes; in marketing this involves the brand, products or services, salespeople, and the establishment where the products or services are bought and sold [54]. This group of beliefs has been divided into different dimensions and trust is usually considered a multidimensional construct that

differentiates between honesty and benevolence perceived in the behavior of the other party. Honesty is the belief that another person will keep his or her word, fulfill promises and be sincere [32]. Benevolence is the belief that one of the parties is interested in the wellbeing of the other without intention of opportunistic behavior [44] and motivated by a search for a mutually beneficial relationship [21]. Some researchers have discussed other dimensions of trust; e.g., in the perceived competence of the second party [75]. This is concerned with the perceived dexterity and ability of the second party [52,77]. Specifically, competence is the degree with which the consumer perceives that the supplier is in possession of the necessary knowledge and skills to complete an agreement or exchange [15]. Perceived competence is especially relevant in an analysis of consumer Internet behavior [67,74]. Thus trust will be considered here as a construct made up of three dimensions: honesty, benevolence and competence perceived in a website. Therefore, we hypothesized that:

H9. Trust has a positive effect on customer loyalty of online retailing.

Customer loyalty

Loyalty has been defined and measured in many different ways [39]. Dick and Basu [20] defined customer loyalty as the relationship between relative attitude and repeat patronage. Also, Novo [60] describes customer loyalty is the tendency of a customer to choose one business or product over another for a particular need. Hence, reason why choosing customer loyalty to be the key construct is that many companies believe that customer loyalty is the key to long-term profitability[72]. Brand loyalty as ‘‘a deeply held commitment to re-buy or re-patronize a preferred product/service consistently in the future, thereby causing repetitive same-brand or same brand-set purchasing, despite situational influences and marketing efforts having the potential to cause switching behavior.’’[63]Also, behavioral, or purchase, loyalty consisted of repeated purchases of the brand, whereas attitudinal loyalty included a degree of dispositional commitment, in terms of some unique value associated with the brand [10]. Thus, we define customer loyalty as a customer’s favorable attitude toward the service provider that results in repeat buying behavior.

RESEARCH METHODOLOGY

Measures and procedure

An online Web-based survey was the predominant measuring device used in this research. The unit of analysis was an individual user of an online retailing system, and the population consisted of individuals who use it for purchasing items. For all variables in this research we used multiple item (5-point, Likert-type) scales. A questionnaire was developed to measure

the relevant constructs. Also, in order to target online users, a Web-based survey was employed. There are several advantages with web-based surveys rather than traditional paper-based surveys: (1) the sample is dispersed worldwide, not restricted to some specific geographical locations, (2) lower costs, (3) faster response time/ quickly, and (4) higher response rate are likely. We also placed an advertisement which offered a prize to make the try to improve the number of high-quality responses.

Questionnaire design and data collection

We adopt the quantitative methodology in this research; thus, a questionnaire was designed after the research model was established. Defining a construct's theoretical meaning and conceptual domain is necessary to develop appropriate measures and obtaining valid results [13,29].

This research integrated three research frameworks from prior studies to measure web quality (system/ information/ service), ease of use, usefulness, trust, customer satisfaction and loyalty [1,19,25]. To ensure content validity of the scales, the items must represent the concept about which generalizations are to be made. Therefore, the technique of relevant literature reviews is employed in this procedure. In addition, to keep with consistency, we modify and make them relevant to adapt in our research context.

There are 696 respondents who self-administered a 54-item questionnaire. For each question, respondents were asked to indicate their agreement or disagreement with the survey instruments using a five-point Likert-type scale. A survey of 696 users of Taiwan's biggest bulletin board system (BBS) named PTT– "E-shopping billboard" was conducted to test our model. Consistent with prior investigations on EC field, we measured demographic variables including gender, age, education, occupation, and the experience of online shopping. Most respondents were students and all the respondents had prior experience in online shopping. The respondents averaged 24.9 years in age and had 8.4 years of experience with computers; with their experience of shopping online, the frequency is as follows: week (8%), month (39%), quarter (26%), half year (19%), and over one year (9%). The male-to-female ratio was approximately 0.88 to 1.

DATA ANALYSIS AND RESULT

Analysis of measurement reliability and validity

Based on responses, reliability and validity estimates were completed. Reliability of the method was evaluated using Cronbach's alpha. Most of the values were above 0.8 (system

quality = 0.815; information quality = 0.805; service quality = 0.8; perceived ease of use = 0.869; perceived usefulness = 0.815; customer satisfaction = 0.876; trust A = 0.834; trust B = 0.771; trust C = 0.847; customer loyalty A = 0.852; customer loyalty B = 0.786), exceeding the common threshold value recommended by Nunnally [61], the final instruments, listed in Table 1. After recognizing the high reliability, the confirmatory factor analysis (CFA) was evaluated to examine the convergent and discriminant validity. Convergent validity, which is the degree with which the items of a given scale are measuring the same underlying latent variable, was assessed with three distinct criteria recommended by Anderson and Gerbing [2]. First, standardized factor loadings, which are indicators of the degree of association between a scale item and a latent variable, are each highly significant, while Hair *et al.*[33] suggests that factor loadings greater than 0.50 were considered to be very significant. Second, composite reliabilities, which are similar to Cronbach's α, exceed the customary lower limit of 0.70. Third, average variance-extracted (AVE), exceed the 0.50 lower limit recommended by Fornell and Larker [26]. As a result, The instruments exceed generally accepted validity and reliability standards for basic research.

Table 1. Reliability and Standardized Factor Loading of Each Measurement

Construct	Item	Standardized Factor Loading	Cronbach's alpha	Construct	Item	Standardized Factor Loading	Cronbach's alpha
System	2	0.813	0.828	Trust A	1	0.775	0.848
Quality	3	0.806			2	0.869	
	5	0.765			3	0.86	
	6	0.829			4	0.772	
Information	2	0.825	0.739	Trust B	7	0.807	0.693
Quality	3	0.857			8	0.865	
	4	0.750			9	0.812	
Service	2	0.911	0.817	Trust C	12	0.858	0.838
Quality	3	0.911			13	0.886	
					14	0.863	
Perceived	3	0.749	0.852	Customer	1	0.754	0.893
Ease of Use	4	0.810		Satisfaction	2	0.801	
	5	0.802			3	0.81	
	6	0.779			4	0.792	
	7	0.781			5	0.764	
	9	0.638			7	0.798	
Perceived	3	0.758	0.842	Customer	1	0.88	0.852
Usefulness	5	0.792		Loyalty A	2	0.873	
	6	0.723			3	0.884	
	7	0.743		Customer	4	0.729	0.786
	8	0.784		Loyalty B	5	0.9	
					6	0.874	

Discriminant validity, which refers to the degree to which the operationalization is not similar to (diverges from) other operationalizations that it theoretically should not be similar to by Anderson and Gerbing [2]. First, the correlation between a pair of latent variables should be less than the square-root of average variance-extracted (AVE) of each variable. The test was

applied to every combination of latent variables. Each pairing constructs passed the test. As shown in Table 2, the results satisfy the requirement. Jointly, these suggest adequate convergent and discriminant validity of the measurement.

Table 2. Convergent validity, and discriminant validity of measurement model

Construct	AVE [a]	Shared variance among constructs										
		SQ	SYQ	IQ	PEU	PU	CS	CL B	CL A	TR C	TR B	TR A
SQ	0.83	0.83										
SYQ	0.65	- [b]	0.65									
IQ	0.66	-	-	0.66								
PEU	0.58	0.0484	0.382	0.17	0.58							
PU	0.58	0.205	0.206	0.192	0.51	0.58						
CS	0.62	0.138	0.194	0.154	0.5	0.557	0.62					
CL B	0.7	0.003	0.003	0.002	0.007	0.011	0.014	0.7				
CL A	0.77	0.092	0.072	0.056	0.203	0.289	0.355	0.052	0.77			
TR C	0.76	0.284	0.115	0.084	0.314	0.473	0.52	0.008	0.211	0.76		
TR B	0.69	0.014	0.005	0.004	0.015	0.022	0.025	0.004	0.01	0.018	0.69	
TR A	0.67	0.25	0.101	0.074	0.277	0.417	0.458	0.007	0.186	0.332	0.016	0.67

AVE = average variance extracted.
[a] Average Variance Extracted = Σ (Standardized Loading 2)/Σ (Standardized Loading) 2 +Σεi
[b] "-"means that it is not been studied in this research.

Model testing results

After evaluating the reliability and validity, we tested the overall fit of our path model examined the estimated coefficients of the causal relationships between constructs that validated the hypothesized effects. To assess its fit before analyzing the path coefficients of our research model, standard measures of absolute, incremental, and parsimonious fit were used [51], it is standard practice to report measures.

We report measures of absolute fit: normed chi-square, goodness-of-fit index (GFI) and the root mean square error of approximation (RMSEA) [80]; as well as measures of incremental fit: adjusted goodness-of-fit index (AGFI), non-normalized fit index (NNFI), normed-fit index (NFI) and comparative-fit index (CFI); and measure of parsimonious fit: parsimonious normed fit index (PNFI) and parsimonious goodness-of-fit index (PGFI). The GFI, AGFI, NFI, NNFI, and CFI range from 0.0 (no fit) to 1.0 (perfect fit) with values between 0.80 and 0.89 considered acceptable and a good model fit while values above 0.90 are most desirable. [4,7,71,84]. Smaller values of RMSEA (less than or equal to 0.08) are considered to show good model fit. [7], and a value less than 0.05 is considered a very good fit of the data [8]. The results of conducting how well the data fits are as follows: Normed Chi-square = 3.08, Goodness-of-Fit (GFI) = 0.850, Root Mean Square Error of approximation (RMSEA) = 0.055, Adjusted goodness of fit index (AGFI) = 0.830, non-normalized fit index (NNFI) = 0.883,

Normalized fit index (NFI) = 0.848, Comparative fit index (CFI) = 0.90, parsimonious normed fit index (PNFI) = 0.787 and parsimonious goodness-of-fit index (PGFI) = 0.752. Although some of them fail to meet the recommended minimum level, i.e., ≧ 0.9. Overall, summarizing the results of our analysis, the hypothesized structural model has a mediocre fit. Thus, all the nine indices indicate that the model fit is acceptable for assessing the results for the structural model. The fit indices for each construct are listed in Table 3.

Table 3. Goodness-of-fit measures of the research model

Fit index	Scores	Recommended cut-off values
Absolute fit measures		
Minimum fit function chi-square	(x2) 2466.7 (p = 0.00)	The lower, the better
Degrees of freedom (d.f.)	799	
x2/d.f.	3.08**	<5
Goodness-of-fit index (GFI)	0.850**	>0.80
Root mean square residual (RMSR)	0.055**	<0.08
Incremental fit measures		
Adjusted goodness-of-fit index (AGFI)	0.830*	>0.90
Non-normalized fit index (NNFI)	0.883*	>0.90
Normalized fit index (NFI)	0.848*	>0.90
Comparative fit index (CFI)	0.90**	>0.90
Parsimonious fit measures		
Parsimonious normed fit index (PNFI)	0.787**	The higher, the better
Parsimonious goodness-of-fit index (PGFI)	0.752**	The higher, the better

Acceptability: (*) acceptable and (**) desirable.

Consistent with our hypotheses, system quality had a significant positive effect on usefulness (β= 0.095, P < 0.05), ease of use (β= 0.483, P < 0.001), and trust (β= 0.083, P < 0.01) as well as information quality also had a significant positive effect on usefulness (β = 0.204, P < 0.001), ease of use (β= 0.396, P < 0.001), and trust (β= 0.080, P < 0.05); moreover, service quality had a significant positive effect on usefulness (β = 0.221, P < 0.001), ease of use (β= 0.150, P < 0.001), and trust (β= 0.214, P < 0.001) as well. Hence, hypotheses H1 to H3 were supported. Furthermore, ease of use influence significantly on customer satisfaction (β = 0.145, P < 0.05) and usefulness also had a significant positive effect on customer satisfaction (β = 0.646, P < 0.001); also ease of use influence significantly on usefulness (β = 0.513, P < 0.001). Thus, hypotheses H4, H5, and H6 were supported. On the other hand, hypothesis H7 was found that customer satisfaction put a significant factor in determining trust (β= 0.545, P < 0.001) and also found that there is a significant impact on customer loyalty (β= 0.170, P < 0.05), H8 supported. Finally, hypothesis H9 had to be rejected because it did not show sufficient statistical significance between trust and customer loyalty (β= 0.130, P > 0.05).

In our research, the path coefficients values indicated a very good fit for all constructs. Therefore, we were assured that the path diagram for our research model was an adequate representation of the entire set of causal relationships (see Figure 2).

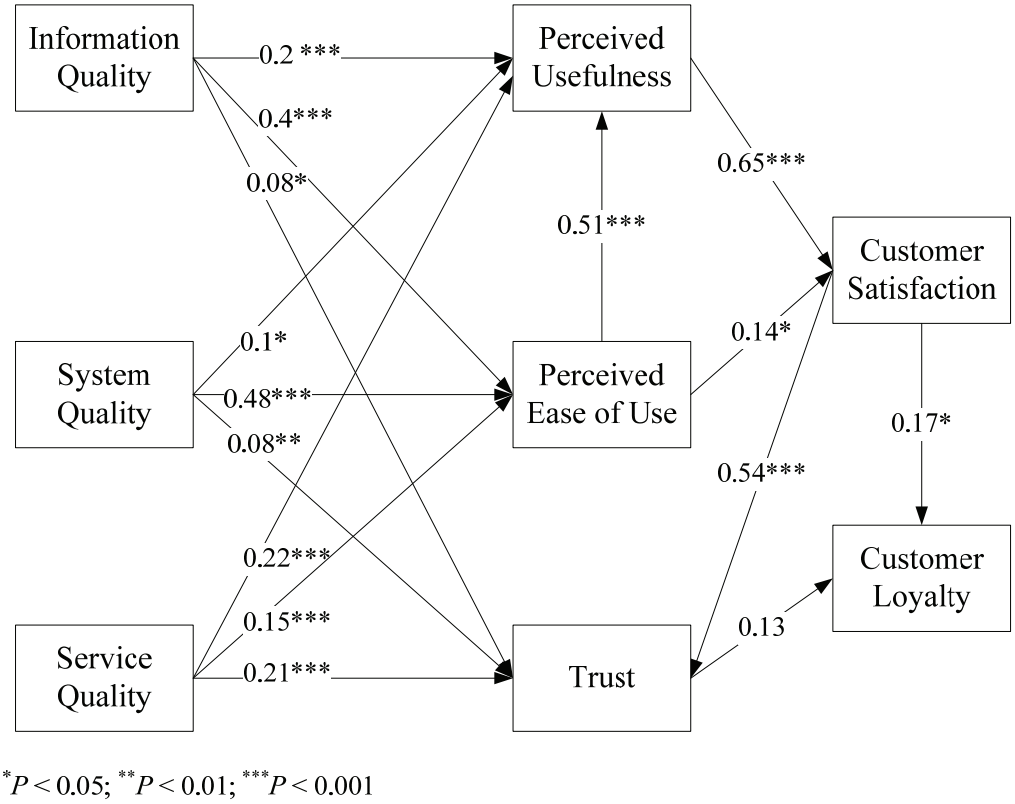

Figure 2. Model testing results

CONCLUSION

Discussion and suggestion

In our model, we found that web qualities (including system quality, information quality, and service quality) appear to be significant determinants of ease of use, usefulness, and trust. Apparently, e-retailers' platform with a well-function system interface, well-organized information displaying, and high-delivered service quality will enhance customers beliefs in operating easily and feeling more comfortable and safe shopping with this platform. Accordingly, contributes to a higher level of customer satisfaction and loyalty. Customer satisfaction and loyalty are always used as observed variables of evaluating customer relationship strategy, i.e. customer retention, re-purchasing [6,30,55]. Therefore, increasing customer satisfaction and loyalty, in other words, might increase the probability of customer relationship in e-retailers.

Here, among these three web quality factors, i.e., system, information, and service quality, we can see information and service quality show higher influence on usefulness compared with system quality. This can be explained that when purchasing online, customers tend to be more dependent and concentrate on browsing and seeking the specific, right, and real-time product

information and completed pre-and after-sales service they really need for choosing e-retailers and determining their purchasing decision. In addition, all these three factors influence significantly on ease of use, implied that as Internet developed for more than 10 years, e-shopping platform is getting more and more mature, regardless of safety mechanism, system design and information gathering. All of the web constructs is easy to understand and use for customers.

For two mediators, i.e., ease of use and usefulness, affect customer satisfaction directly; from our model, the result reveals that these two mediators are significant factors affecting customer satisfaction. It reveals that e-retailer's platform with an easy to use function-design and useful information/ service trade context can contribute to customer satisfaction in e-retailing. Furthermore, consistent with prior studies [19,78], there exists positive and highly correlations among these three factors. Particularly, the relationship between usefulness and customer satisfaction is the most significant. It illustrates that customers may be more interested in the target e-retailer while its platform is more useful. Continuously, with the three web quality put direct effects on trust, customer satisfaction also have positive effects on trust – the higher satisfaction customer perceived will have more trust on the e-retailer because trust will not be perceived by customer in the first time, acquiring customer's trust need experience and time. For this reason, once customer has purchasing experience and satisfied with it, he/she will have more confident shopping in particular e-retailer which gets customer enjoyable and product/service guarantee, then becoming old customer after continuous no-error shopping experiences. With above-mentioned conditions, here comes customer's trust on e-retailer. On the other hand, customer satisfaction has stronger significant effects on loyalty than trust. This suggests that the effect of trust on loyalty does not follow a direct path. This finding indicated that customer loyalty can be affected directly by satisfaction; it did not need to be conditioned by trust. As we can see from prior studies, customer satisfaction had positive relationship with customer attitude [70].That is customer have more positive attitude to the e-retailer once customers are satisfied with its product delivery or service. Hence, customer satisfaction influenced customers' attitude toward e-retailers and also affected on their willingness to purchasing with the same e-retailer and enhance its loyalty.

Our findings illustrated a balanced framework which can support the viewpoint that e-retailing is not just an information system (IS) but also regards it as a service provider supporting customer purchasing process and offering rapid response time. E-retailers can enhance web quality through investing time and resources when designing and operating the platform to provide better shopping environment and safety mechanism to reduce the difficulties in using and making transactions on the platform, or customers will move to

competitor sites. Also, service may be the most important during the after-sales period because time delivery, follow up service, and problem resolution are required. As a result, e-retailers should also be aware of the offline features of e-retailing. The customers consider the platform not merely as an IS but also as a virtual store that provides full service will be more likely to retain customer loyalty.

Conclusion

To sum up, this research successfully demonstrates the empirical evidence of a positive relationship among web quality, user belief (including perceived ease of use PEOU and usefulness PU), trust, customer satisfaction and loyalty in an inimitable e-retailing context. The result of our research raises attention on what factors are valued for customers and affect the performance of customer loyalty using the specific model proposed in this research, particularly web quality and its follow-up effects. These findings can help practitioners and researchers understand how to obtain customer loyalty via developing friendly website and useful functions, providing satisfying products and service. They also will be valuable to researchers in developing and evaluating e-retailer's CRM performance.

Limitation and future research

There are, of course, limitations in our research. First, although we raised the model for testing the determinants, i.e. web quality, PEOU, PU, trust, and customer satisfaction for customer loyalty of e-retailing, nevertheless, other factors may play an important role in impacting on customer loyalty. As a result, we suggest that future studies can try to find other variables or statistic variables affecting customer loyalty. Second, in this research all the variables were based on e-retailing measures. Third, only viewing online customer loyalty building, we did not consider the elements and impacts of the traditional retailers versus the e-retailers. Since consumers are exposed to both offline and online channels, integration is important. Accordingly, this study encourages any follow-up researchers to aim at different kinds of channels to find out some critical factors affecting both traditional retailers and e-retailers or their difference for enriching the study about the determinants of customer loyalty in EC context. Final, the generalization of the results is limited by the context of e-retailing in Taiwan: all of these observations were from Taiwan and e-retailing in other countries may not resemble those in Taiwan.

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AN EXAMINATION OF THE DETERMINANTS OF LOYLATY IN E-TELECOMMUNICATION INDUSTRY

Bruce C. T. Ho, Switch J. C. SU
Institute of electronic commerce, National Chung-Hsing University, Taiwan
yam921@gmail.com

ABSTRACT

The purpose of this paper is to investigate how perceived website usability, trust, perceived value, customer satisfaction and habit affect customers' loyalty to particular e-telecommunication website they visit. A Web-based survey was conducted to test our model, and data were collected from 517 users of e-telecommunication websites in Taiwan. Structural modeling techniques were used to test the model and its hypotheses. The data was analyzed by AMOS, which is a plug-in application of SPSS software. The result of the research indicates that the loyalty of the user increases when the user perceived the website was usable. The result also demonstrates that greater usability is found to have a positive influence on user satisfaction. Furthermore, users' perceived value was found to have a positive influence on user satisfaction and loyalty, and habit is a driver of trust and loyalty. Also, the result can be a reference for those practitioners to investigate how website development affects customers' perception.

Keywords: E-telecommunication; Website usability; Loyalty

INTRODUCTION

Nowadays, the development of cell phone features has been much more completed; many cell phone users can easily enjoy the entertainment on cell phone, i.e. ring-tones, wallpapers, and games. With the huge progress on technology, anyone can easily download their favorite ring-tones, simply enter their phone number on the website, and then receive the instant music. Ring-tone downloading enables people to access the most popular and latest ring-tones in any type of music and it becomes an interesting phenomenon, highlights the development of modern technology. And games, wallpaper and screensaver allow users to have a personalize cell phone. In order to gain profit, many website built up for providing these kinds of service called e-service, including the e-telecommunication websites.

In this research, the factors that influence the continuous of using an e-telecommunication website were discussed. This kind of e-service creates the way that many e-commerce and telecommunications applications are provided. In order to develop strong business strategies

and build up customer value, e-service providers must not only attract new customers but also be able to keep them to ensure profitable. In e-service industries, the high cost of acquiring customers can make many customer relationships unprofitable in the early years. But, without customer loyalty, even the best e-service will lose.

Three constructs have been used in prior research on website's continued use/continuance intention: website usability, satisfaction, and trust, which were proposed by Flavian *et al.,*[23]. To the online service where customer retention is a key success factors, it is necessary to develop effect website design and operation, or usability. An organization with poor website usability or ineffective services may project a poor image and weaken the organization's position. Therefore, it is critical to determine the factors that enhance user's attitude and their website use. Individuals would visit a site if it provided high quality service at low price with fast delivery. A satisfied customer results when a purchase seems as economical but there is also satisfaction when the experience was pleasurable. Studies have shown that the likelihood of a repeat visit to a website is enhanced when the visitor has found the website is usable [23]. We look at trust between customers and e-service in consumer-based e-commerce. For any type of transactions, electronic or traditional, trust is the most critical factor for successful outcome and build up stable relationship. Trust is even more important in electronic transaction.

We add the construct of habit and perceived value to the above three constructs. Habit reflects automatic behavior tendencies developed during the past history of the individual [48]. When behavior is repeated and becomes habitual, it is guided by automated mental processes, rather than by detail decision processes [1]. Thus examining the effect of habit on website loyalty can improve our understanding of e-commerce and website adoption. Effective marketing requires good knowledge of the underlying needs and value perceptions of the specific user segments. People who do not have any experience of using such services may have difficulty in realizing the real value of the service/products. The companies need to understand how the service brings value to customer's everyday life in order to keep them visiting the website. Hence, customer perceived value plays an important role in make customers use the website.

In increasingly competitive markets, being able to build consumer loyalty is seen as the key factor in winning market share and developing a stable competitive advantage. While the importance of customer loyalty has been recognized in marketing literature for at least decades [12,14,16]. The development and empirical validation of a customer loyalty model in an e-telecommunication context had not been addressed.

Thus, the purpose of this paper is to develop and validate a customer website loyalty model

for e-telecommunication website in e-commerce. Based on our findings, the telecom companies should be able to understand the critical factors affecting customer loyalty on e-telecommunication website.

LITERATURE BACKGROUND AND HYPOTHESIS

The proposed framework is illustrated below in Figure 1. Its components which including perceived website usability, customer satisfaction, perceived value, trust, customer loyalty, and habit are discussed in this section. This review presents an overview of relevant literature leading to the establishment of the proposed framework.

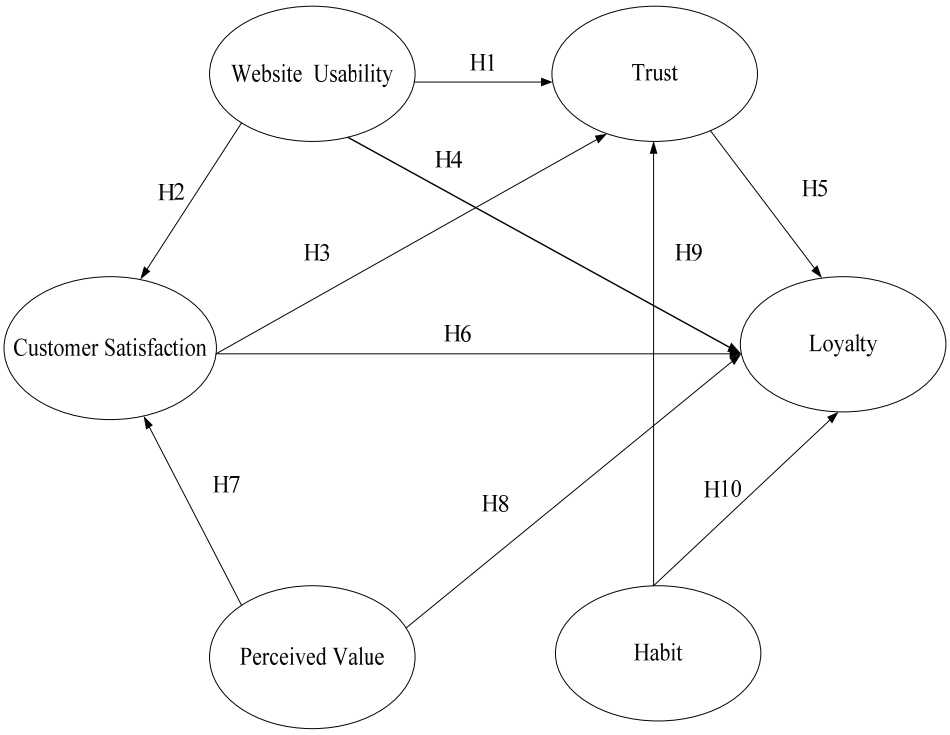

Figure 1. The proposed framework

Website usability

Website usability plays an important role in attracting and keeping customers. Nowadays, it is usually associated to ease-of-use of a website and is considered a critical factor on the development of electronic commerce. A high usability website not only affects the customer's purchase decision but also is one of the main reasons for consumers to determine whether they will purchase online or not [23,58]. Websites which lack of usability can result in loss of customers to competitors and reduction in profits. Therefore, it is necessary to understand how website usability affects consumers' beliefs about the website, which in turn leads to

loyal customers [23].

Usability, according ISO 9241-11, includes effectiveness, efficiency and satisfaction with which specific users achieved specific goals while using a product. Speaking of website, usability means perceived ease of navigating the site or purchasing on the Internet [23]. Following definitions of Nelson [57], it suggested that "*is a quality attribute that assesses how easy user interfaces are to use*". It involves the ease with which the user can learn to accomplish basic tasks and recover from the errors, the efficiency of design of the site, and the general satisfaction of the user [56]. Even though usability would be an important issue for website maintaining, there is little related research in Taiwan. The same perspective was adopted by many researchers to measure quality of many systems in other fields [7,11,18,19,77].

In order to keep customers visiting their website, eventually purchasing services or products, usability is a critical importance for achieving the satisfaction of the user [41]. People have low tolerance for difficult design and low websites. They prefer to grasp the functioning of the site as soon as possible and searching the product information and complete the transaction quickly [58]. Otherwise, they would choose another website for the same product or service. Website usability is the first impression that customer experienced, and it is one of the most important factors that influence customers' satisfaction [68].

Trust

Trust in B2C ecommerce is defined as the belief that allows consumers to willingly become accessible to web retailers after having taken the retailers' characteristics into consideration [65]. As in prior studies, trust has been defined and divided into different dimensions and it is usually considered a multidimensional construct as following: Honesty, benevolence and perceived competence. Honesty is member's belief that one partner will keep his/her words, and be reliable and sincere to fulfils promised role obligations [5,29]. Benevolence is a belief that its partner is genuinely interested in one's interests or welfare and is motivated to seek joint beneficial relationship [17,22,45,68]. Perceived competence is the degree with which the consumer perceives that the supplier has sufficient and necessary knowledge and skills to complete an agreement or exchange [15,69], and it is related to analysis of consumer Internet behavior especially [65,68].

On the Web, customers generally stay away from electronic retailer because they do not trust [36,66]. They think brick-and-mortar business gives them a stronger sense of privacy or reliability that protects any exchange of financial information. Moreover, consumers find it difficult to assess whether the retailer will keep their promises on its commitments or protect

the privacy of personal information [32]. Lack of trust is still a barrier of e-commerce growth. The relationship between trust and usability had been discussed. Nielsen and Norman [58] and Roy *et al.,* [68] argued that website usability may influence the perceptions of the consumer about the website and the expected degree of trust eventually. Several arguments about the influence of usability on trust are stated. First, greater usability can help users to achieve an objective much easier (e.g. make orders), which can improve customer trust because the error reduced [54]. Second, suitable website design favors feelings of pleasure in use of the website. Hence, greater usability can provide comfortable atmosphere that can improve consumer perception positively [6]. Based on these, we hypothesis that

H1: Website usability will affect the degree of trust positively.

Satisfaction

Satisfaction was explained that it is determined by the intensity and direction of the gap between expectation and perceived performance. Following Oliver [60], Satisfaction is a consumer's post-purchase evaluation and affective response to the overall product or service experience. An individual is more likely to be satisfied if the service performance meets or exceeds his/her expectations. On the other hand, he/she is more likely to be dissatisfied if the service performance fails his/her expectations. DeLone and McLean [20] suggest that user/customer satisfaction may be assumed to be the determinant of net benefit or individual impact.

Some researcher has looked at factors that influence levels of Internet satisfaction among website users [13,40]. Flavian *et al.,* [23] indicated the influence of website usability on the degree of Internet consumer satisfaction. As a result, we hypothesize the following:

H2: Website usability has a positive effect on satisfaction of the website.

Customers' satisfaction with the buying experience on the website is proposed to have a positive impact on his/her trust of it. Trust should be greater when the satisfaction that the business or product gives the consumer is greater [39]. Previous research has shown that constructs of trust and satisfaction are positively correlated, but the causal ordering of the two has been argued [14]. Both concepts are similar in the sense that they represent some overall evaluation, feeling, or attitude about the other party in the relationship [70]. The consumer will feel satisfied if he perceives the fulfillment of the required level of honesty, benevolence and competence in the website [23]. Therefore, as satisfaction can act as an antecedent of trust, we formulate our hypothesis:

H3: Website customer satisfaction has a positive effect on trust in the same website

Website Loyalty

Keller [38] stated that loyalty is a favorable attitude toward a brand resulting in consistent purchase of the brand over time. Chaudhuri and Holbrook [12] stated that loyalty consisted of repeated purchases of the brand, whereas attitudinal loyalty included a degree of mental commitment. The importance of consumers' brand loyalty is approved and researchers have shown great interests to extend it to the Internet market [2].

As a consequence of the growing importance of Internet services, consumers' positive attitude in the traditional market can be extended to the website in the B2C e-commerce market. Website loyalty seems to depend on cognitive lock-in, which is a consumer skill in managing and controlling the website [37,55]. The acquisition of the necessary skills will not only depend on the time dedicated by the consumer to managing the website, but also on the facilities that the website offers its users. Thus, it is reasonable to believe that the level of usability may help the individual to develop a degree of ability that will ensure that the website occupies a favored position compared to the other channels, and then enhance the level of loyalty. Therefore the hypothesis was stated:

H4: Website usability has a direct and positive influence on website loyalty

Loyalty has been stated that it directly depends on the degree of trust [46,52]. Lin and Wang [50] also pointed out that trust is a critical factor in re-purchasing, or loyalty. Chiou [14] stated that perceived trust had direct and positive impacts on the satisfaction and loyalty of customers. We expected these variables and relationship can apply to e-telecommunication context, so the following hypothesis is stated:

H5: Trust on the website has a direct and positive influence on loyalty towards the same website.

Customer satisfaction is one of the most important criteria for loyalty. [34]. Several studies observe a strong link between customer satisfaction and loyalty [3,9,25]. Customer loyalty may be regarded as a repeat (purchasing) behavior directly toward a certain company's product or brand; therefore, it may be concluded that customer loyalty may be influenced by customer satisfaction (attitude). As a result of the growing importance of Internet services, a number of researchers have attempted to find ways to improve website loyalty and increase the consumer's intention to buy [2,71]. More specifically, if the consumer believes that the website will fulfill the agreed conditions, they believe that this behavior will continue and their preference to develop the relationship will increase. That is, the alternative choices will be less attractive. Hence, the following hypothesis is proposed:

H6: Customer satisfaction with the services offered by a website has a direct and

positive influence on loyalty towards the website.

Perceived value

According to Zeithaml [78], perceived value is assumed to include a consumer's assessment of the ratio of perceived benefits to perceived costs. Parasuraman and Grewal [62] say that perceived value is involved in 'get' component (the benefits a buyer derives from a seller's offering) and a 'give' component (the buyer's costs of acquiring the offering). This study was focused on website information, system, and product quality as the 'get' component, and on money and time spent as the 'give' component. The significance between perceived value and satisfaction has been identified in the literature [16,31,64]. On the Web, if customers perceive that they can complete purchasing with less time and more convenience and accuracy, they attend to have positive feeling toward the website. Thus, the following hypothesis was stated:

H7. Perceived value has a positive effect on customer satisfaction.

Prior studies supported the general notion that perceived value is an antecedent of customer loyalty [21,63]. Anderson and Srinivasan [3] suggested that when the perceived value increased, customers would be more intended to continue to use the same website to complete businesses, thus contributing to a improvement in loyalty. Thus, the hypothesis was:

H8. Perceived value has a positive effect on customer loyalty on the website.

Habit

Purchase and consumption behaviors in daily life often are repeated and performed in customary places, leading consumers to develop habits. According to prior studies on habit, it is an automatic and learned behavior, which emerge from response repetition and is always limited in scope [61,75]. Gefen [28] says that habit is what one usually does; it is a behavioral preference in the present. Users learn more about how to operate the technology and gain more advantages through habitual prior use of a specific information technology or facility.

Satisfactory experiences can result in repeating the same behavior [1]. Tan [74] stated that consumers trust the website based on a history of previous interactions and positive experiences with the website because web retailer did not cheat on them, and they are the primary reasons for trust. Moreover, according to Gefen [28], through habitual use of a website, user can increase their understanding of the website and should become more familiar with the website. Therefore, we hypothesized that

H9. Habitual activity with a website will positively affect user's trust on the website.

Habit can explain a large proportion of the variance in the continued use of a website [28]. Those who visit the websites are out of habit rather than through their evaluation of the perceived benefits and costs. Once a behavior becomes a habit, it indicates a well-practiced behavior, then it was thought as an antecedent of behavioral intension, or habit can directly affect behavioral intentions of repeat purchase [61]. With these literature findings, customers' intentions of repeat purchases, or loyalty on a specific website will affected positively by habitual visiting the website. So we hypothesized that:

H10: Habit has a positive effect on customer loyalty.

RESEARCH METHOD

Measurement Development

Items selected for the constructs were primarily derived from prior studies. Scales measuring the constructs were based on previous studies whenever possible. In order to guarantee the content validity of the questionnaire, we first analyze previous literatures. The items were developed based on the definitions of website usability stated by Roy *et al.,* [68], Lin *et al.,* [49], Kirakowski *et al.,* [42] and Flavian *et al.,* [23]; The proposals of Kumar *et al.,* [44], Siguaw *et al*., [72], Doney and Cannon [22], and Roy *et al*., [68] were used for trust; Satisfaction were measured using seven items respectively from a previous validated questionnaire developed by Brockman [10], Janda *et al.,*[35] and Smith and Barclay [73]; while the concept of loyalty made reference to the work of Rowley and Dawes [67], Yoon and Kim [76], and Flavian *et al.,*[24]. Perceived value were using three items from validated questionnaire developed by Lin [50]. Finally, three items for habit were adapted from Gefen [28].

To fit the e-telecommunication website context, some descriptions had to be changed. Therefore the descriptions were reworked to clarify the meaning of each item.

Data Collecting

A Web-based survey was performed in order to target the online users. The questionnaire consisted of separate Web browser windows containing the items to be assessed. The respondents were then asked to answer all questions based on their experience when using that particular e- telecommunication website. 579 responses were collected. After deleting 62 invalid responses, 517 remains, showed valid rate of 89.3%.

ANALYSIS RESULTS

Analysis of Reliability

Reliability is the consistency of a set of measurements or measuring instrument if repeated measurements are made [43,51], and it was evaluated by assessing the internal consistency of the items representing each factor using Cronbach's alpha. As presented as follow, all Cronbach's alpha is exceeding 0.7, which imply the alpha reliabilities for each factor were appropriate [59], which were: Website usability = 0.86; Perceived value = 0.748; Satisfaction = 0.914; Habit = 0.843; Honesty = 0.834; Benevolence = 0.777; Competence = 0.885; Loyalty_A = 0.873; Loyalty_B = 0.763.

Convergent and Discriminant Validity

The convergent and discriminant validity of the multiple-item scales were tested with confirmatory factor analysis (CFA). Convergent validity, which is the degree with which the items of a given scale are measuring the same underlying latent variable, was assessed with three distinct criteria recommended by Anderson and Gerbing [4]. First, standardized factor loadings, which are indicators of the degree of association between a scale item and a latent variable, are each highly significant, while Hair *et al.,*[30] suggests that factor loadings greater than 0.50 were considered to be very significant. The result presented in table 1. Second, composite reliabilities, which are similar to Cronbach's α, exceed the customary lower limit of 0.70. Third, average variance-extracted (AVE), exceed the 0.50 lower limit recommended by Fornell and Larker [26].

Discriminant validity, which refers to testing statistically whether two constructs differ, was assessed with one test recommended by Fornell and Larcker [27]. That is, the correlation between a pair of latent variables should be less than the square-root of average variance-extracted of each variable. The test was applied to every combination of latent variables. Each pairing passed the test.

Table 1. Standardized Factor Loading of Each Item

Construct	Items	Standardized Factor Loading	Construct	Items	Standardized Factor Loading
Website Usability	5	0.731	Honesty	4	0.838
		0.723			0.865
		0.681			0.757
		0.693			0.822
		0.755	Benevolence	2	0.891
Perceived Value	3	0.828			0.842
		0.854	Competence	4	0.689

		0.761			0.771
Satisfaction	7	0.757			0.802
		0.828			0.779
		0.827	Loyalty A	3	0.702
		0.773			0.819
		0.817			0.849
		0.830	Loyalty B	3	0.785
		0.807			0.751
Habit	3	0.837			0.778
		0.894			
		0.837			

As shown in Table 2, the results satisfy the requirement. Jointly, these suggest adequate convergent and discriminant validity of the measurement.

Table 2. Reliability, convergent validity, and discriminant validity of measurement model

Construct	α	$\sqrt{AVE}$	Correlation among constructs								
			PUA	PV	HON	BEN	COM	CS	HA	CL_A	CL_B
PUA	0.860	0.72	(0.72)								
PV	0.748	0.82	-	(0.82)							
HON	0.834	0.82	0.087	0.118	(0.82)						
BEN	0.74	0.87	0.016	0.022	0.244	(0.87)					
COM	0.885	0.76	0.002	0.003	0.036	0.007	(0.76)				
CS	0.914	0.81	0.65	0.445	0.097	0.018	0.003	(0.81)			
A	0.843	0.87	-	-	0.158	0.029	0.004	-	(0.87)		
CL_A	0.873	0.79	0.235	0.341	0.053	0.010	0.001	0.412	0.403	(0.79)	
CL_B	0.763	0.77	0.183	0.266	0.041	0.008	0.001	0.321	0.314	0.10	(0.77)

AVE = average variance extracted (also in parentheses)
"-": Not studied in this research.

Model Testing

The structural models are evaluated on the basis of four goodness-of-fit measures. A widely used fit measure is the statistical significance of the χ^2 statistic, which indicates whether the model has a poor fit with the data. But it is not always straightforward because it is very sensitive to sample size. Due to the large sample size, χ^2 is not an appropriate measure of goodness-of-fit in this study. The fit indices were summarized in Table 3. The various fitness indices for the model suggest that the theoretical model provides a tenable fit.

Table 3. Goodness-of-fit measures of the research mode

Fit index	Scores	Recommended cut-off values
Absolute fit measures		
Minimum fit function chi-square χ^2	1620.1	The lower, the better
Degrees of freedom (d.f.)	545	
χ^2 /d.f.	2.97**	<5
Goodness-of-fit index (GFI)	0.849*	>0.80
Root mean square residual (RMSR)	0.065**	<0.08

Incremental fit measures	0.826**	>0.80
Adjusted goodness-of-fit index (AGFI)	0.873*	>0.90
Tucker–Lewis index (TLI) or (NNFI)	0.835*	>0.90
Normed fit index (NFI)		
Parsimonious fit measures	0.765**	The higher, the better
Parsimonious normed fit index (PNFI)	0.735**	The higher, the better
Parsimonious goodness-of-fit index (PGFI)		

Acceptability: (*) marginal and (**) acceptable.

Testing Hypotheses

The fit statistics and estimated path coefficients for the proposed model are reported in Figure 3. Except for one causal paths, all other hypothesized relationships were statistically significant ($p<0.05$). The statistically insignificant path is the effect of website usability on trust.

The effect of perceived website usability on customer satisfaction ($\beta= 0.831$, $p < 0.001$) and website loyalty ($\beta = 0.159$, $p < 0.05$) were significant. Thus, it was not possible to reject hypotheses H2 and H4. On the other hand, hypothesis H1had to be rejected because it did not show sufficient statistical significance between website usability and trust ($\beta= 0.051$, $P >0.05$). Customer satisfaction was found to be a significant factor in determining trust ($\beta= 0.326$, $P < 0.001$) and website loyalty ($\beta= 0.231$, $P < 0.001$), supporting hypotheses H3 and H6. Perceived value had a positive and significant impact on both customer satisfaction ($\beta= 0.547$, $P < 0.001$) and website loyalty ($\beta= 0.218$, $P < 0.001$), which validating H7 and H8. Habit was found to influence trust ($\beta= 0.149$ $P < 0.001$), and website loyalty ($\beta= 0.241$, $P < 0.001$) positively, thus H9 and H10 could not be rejected. Finally, as respected, trust was found to be a significant factor in determining website loyalty ($\beta= 0.28$, $P < 0.001$), supporting H10.

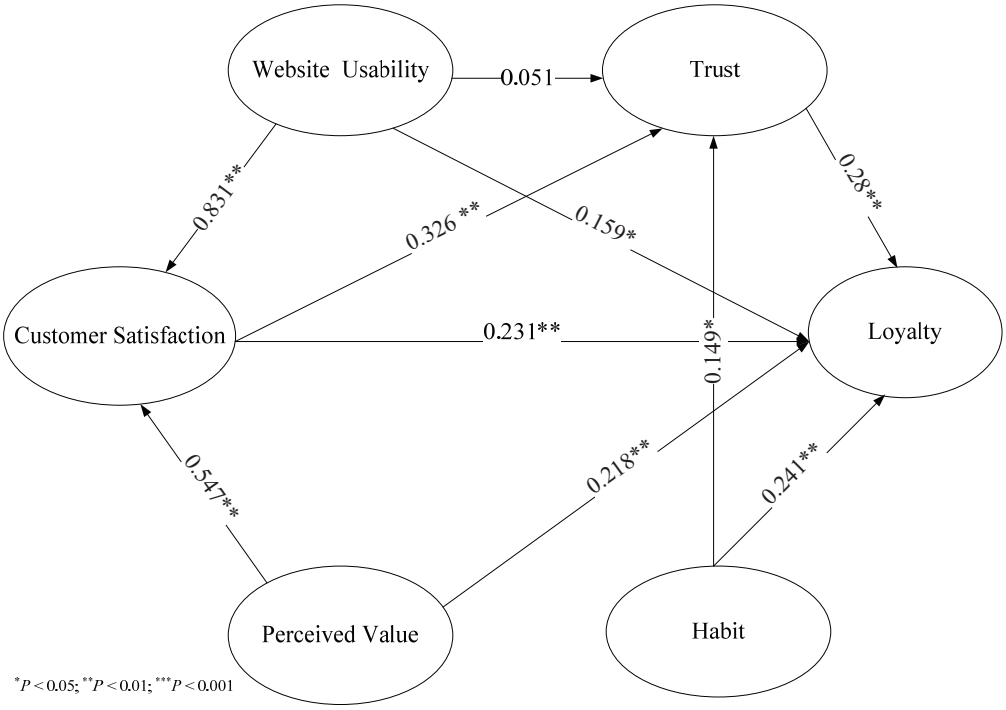

Figure 3. Results of the Structural Equation Model

CONCLUSION

Discussion and suggestion

This research empirically validated existing theories within the context of e-telecommunication websites, investigating the relationship among website usability, perceived value, trust, habit, and satisfaction on website loyalty. It has confirmed that perceived usability has a direct and positive relationship on the degree of consumer satisfaction and loyalty. However, it has shown that the effect of the degree of usability on the degree of trust does not follow a direct path. Moreover, perceived value, trust, habit, and customer satisfaction are significant factors in determining website loyalty.

The result that the website usability significantly affects user satisfaction is in agreement with study done by Flavian *et al.,*[23]. This indicates that customers' perception of website usability is one of the key drivers of satisfaction. The analysis also showed that website usability had a positive influence on loyalty through satisfaction. This finding suggests that

website usability influences customers' repurchase intentions indirectly by means of satisfaction. The telecom companies should understand that improvements in website usability can enhance website loyalty through increased customers' satisfaction. To improve website usability, telecom companies should seek to take effective measures and set standards that guarantee good usability of website. However, the results show that website usability did not significantly contribute to user's trust. While the finding may be true and may need further validation, a possible explanation is that although the customers can easily find the product information showed on the website, they thought it is still not transparent, making them doubts the sincerity of the website. Another possible reason is that no matter how website is usable, customers do not trust whether the company will keep their promises on its commitments or protect the privacy of personal information. In Taiwan, online retailers were been doubted that they sell customers' personal data to the fraud. After entering personal data while customer were purchasing online, they will received many junk mails and strange phone calls from the fraud. These made customers hesitate every time they're asked to enter these data. Therefore, website usability may have no significant impact on trust for online shoppers. This finding indicated that the effect of the degree of usability on the degree of trust does not follow a direct path. Telecom companies should enforce their protection on the privacy of customers to rebuild trust on the website. Nevertheless, website usability can increase trust by increasing satisfaction.

Satisfaction is found to have a significant positive impact on trust and loyalty. This supported prior studies' suggestions that satisfaction directly influence trusting intentions (repeat purchase intentions) [33,50,53], satisfied customers will access the same website in the future. Customer satisfaction has also been considered a mediating variable between trust and customer loyalty. Satisfaction does not depend on website usability alone, but it also depends on customers' value perceptions. Given this finding, telecom companies should ensure that higher levels of usability are worthwhile to the extent that customers' believe that value is being enhanced. Therefore, telecom companies can ensure that customers' perception of value contributes to good levels of satisfaction.

Perceived value has a positive effect on satisfaction and loyalty. This finding indicates that if customers think they are getting high value from the services they receive, they are more likely to be satisfied, access the website to purchase again. To keep customers from switching to competitors, the telecom companies should continuously work at enhancing perceived value. Prior studies support the general notion that perceived value is determined by quality and sacrifice [8,50,79]. Thus, in order to obtain higher customer loyalty, the telecom companies must continuously work to improve the value perceived by consumers, by increasing the quality of their content, product, service and system, and by the reasonable

pricing of their products/services.

Habit has a positive influence on trust and loyalty. This indicates that customers' perception of habit is one of the key drivers of customers' trust and loyalty. One way to increase customer re-use is to encourage the customers to develop the habit of using it. Some barriers may exist when customers are entering the website for the first time. To overcome these, the companies may have to provide more favorable incentives and higher value than competitors do, and encourage consumers to revisit its website, like frequent incentives, value added services, discounts, and personalized service. Once customers begin using the website, and become familiar with it, they may be inclined to continue, if it becomes a habit.

Conclusion

This study has examined the effects of perceived website usability, satisfaction, perceived value, habit, trust, and website loyalty. The framework provided a tenable structure to studying customers' future intension and it demonstrated a good fit exhibited a highly practical significance. Therefore, the framework is a valuable basis for understanding customers' behavioral intentions and contributes to our knowledge of future customers' behavior studies in e-telecom service marketing. Based on the framework of the linkages between constructs, all hypothesized relationships appeared to be statistically significant except for one causal paths. This study conclude that website usability, satisfaction, perceived price, habit, and trust each had a significant influence on customers' loyalty on e-telecom context. These variables were directly or indirectly related to customers' repurchase intentions.

Limitation and Future Research

With regard to the limitation of this research, first, this research investigated website usability, satisfaction, perceived value, habit, trust, and website loyalty, which were combine from prior researches [23,47,50]. However, there are other factors affecting customers' loyalty, i.e. reputation. Future studies can find other variables and other statistic variables, gender, service providers…*et al.*, to discuss. In addition, future scholars can investigate subcomponent via CFA and verify their relationship through hypotheses further. Second, the subjects are e-telecom websites, other website providing the same products were excluded. If future scholars are willing to investigate deeper, they can take those websites into consideration to verify the relationship among these variables. Third, the generalization of the results is limited by the

context of e-telecom in Taiwan: all of the observations were from Taiwan and e-telecom in other countries may not be similar with Taiwan.

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A COMPARATIVE ANALYSIS OF JAPANESE, U.S., AND KOREAN FIRMS ON IT AND MANAGEMENT

Prof. Kazuyuki Motohashi, University of Tokyo, Japan
motohashi@tmi.t.u-tokyo.ac.jp

ABSTRACT

In this paper, the contribution of Information Technology (IT)-use to management performance is compared between Japanese, U.S., and Korean firms, based on an analysis using data of the "International Comparative Survey of Firms' IT Strategies". This survey has been conducted by RIETI (Research Institute of Economy, Trade and Industry) for listed companies in Japan, the United States, China and Korea.

Statistical analysis of this data reveals that Japanese firms have received positive effects from "Mission Critical Systems," which includes regular, daily businesses such as personnel management, accounting information systems, and ordering, whereas U.S. firms are effectively using "Informational Systems," systems that perform intricate analyses of the firm's data, such as supporting management strategies or developing new customers. The results also report that Korean firms are behind Japanese firms in deploying IT systems with the exception of Enterprise Resource Planning (ERP) systems.

The section on the internal IT organization of the firm, which reveals the importance placed by firms in using IT as a tool to accomplish corporate strategy, indicate that U.S. firms place the highest importance, followed by Japanese firms, and finally by Korean firms. With regard to the relation with outsourcing firms of IT systems, U.S. firms are treating outsourcing firms as a partner to consult technology trends whereas a large number of Japanese firms perceive them as a means for cost reduction.

INTRODUCTION

Due to the declining birth rate and the aging population in Japan, productivity growth is the key force to sustain the long term economic growth rate. The effective use of IT systems by firms is reported to be an important factor to increase productivity of the macro economy. According to a macroeconomic comparison of IT and economic growth of Japan and the U.S., the results reveal that the level of IT investments in Japan is not far behind the level of the U.S. (Jorgenson and Motohashi, 2005). Despite the stagnant growth rate experienced by the Japanese economy since the 1990's, Japanese firms have invested heavily in IT due to the swift technological progress of IT and the rapid penetration of the broadband infrastructure. However, it is said that the productivity effects of IT are limited compared with U.S. firms. According to a firm-level analysis on IT network use and productivity of Japanese and U.S.

firms, the results report that the productivity effects of network use is twice the size in U.S. firms compared with Japanese counterparts (Atrostic et al., 2005). Although IT systems are an effective tool to increase managerial performance of firms, the effects of IT systems differ substantially depending on its utilization. In order to achieve greater productivity effects of IT, it is important to understand how firms actually use IT and reveal the obstacles leading to under performance.

Based on the above background, RIETI conducted the "International Comparative Survey of Firms' IT Strategies." In addition to Japanese and U.S. firms where clear productivity differences of IT are reported, this survey also investigates the use of IT in Korean firms, where rapid progress is being observed in the IT sector. The method to measure the level of IT-use of firms is problematic, since the level of IT-use depends on various factors including the industry, the type of business activity, and the size of the firm. For example, the use of IT differs greatly between a small-sized firm of electronics components supplying its products to a large firm, and a large retail firm. In this study, the priority for the firm's managerial strategies is first investigated, and the level of IT- use is compared based on how IT has contributed to achieve these items that the firms perceive as being important for its managerial strategies. For example, an important management goal for a small-sized electronics component supplier may be to provide a variety of products at low costs, as well as expediting the time to deliver its products. For a large retail firm on the other hand, increasing the frequency of visits by its current customers or raising the unit amount of its purchases may be an important management goal. As these examples indicate, the firm's managerial priorities differ depending on the specific circumstance faced by individual firms, but by investigating the contribution of IT systems to achieve each firm's managerial priorities, it is possible to measure the widely disparate IT-use by firms, based on a common metric.

In addition to the contribution of IT to achieve the firm's important management goals, the survey also covers the level of IT system deployment (e.g. IT investment per sales and the coverage of IT systems based on types of businesses), the organizational arrangement of the IT division, and how outsourcing of IT is being conducted. The question on the organization of the IT division was included to investigate the importance placed by firms, from the context of its organization, to achieve its managerial goals using IT. In addition, due to the rapid technological progress and highly specialized skills needed to develop IT systems, the effective utilization of outsourcing often becomes a key to success, which is the reason for including a section on IT outsourcing.

The remainder of the paper is organized as follows. First, the next section explains the

contents of the survey. Section 3 reports the results of the comparative analysis of IT and management for Japanese, U.S., and Korean firms. Since the results of the survey are affected by the industrial sector and the size of firms, a descriptive regression was conducted to control for these effects to reveal the cross-country differences. Section 4 provides an inference of the reported results. In order to find implications for the differences in IT-use by Japanese firms compared with U.S. and Korean firms based on the results obtained in Section 3, it is important to clarify the differences in the environments faced by firms along with economic institutional differences of these countries. In this section, explanations are provided regarding the results of Section 3, focusing on the differences between Japanese and U.S. firms. Finally, Section 5 summarizes the findings of the paper and provides future directions of research.

Overview of the survey

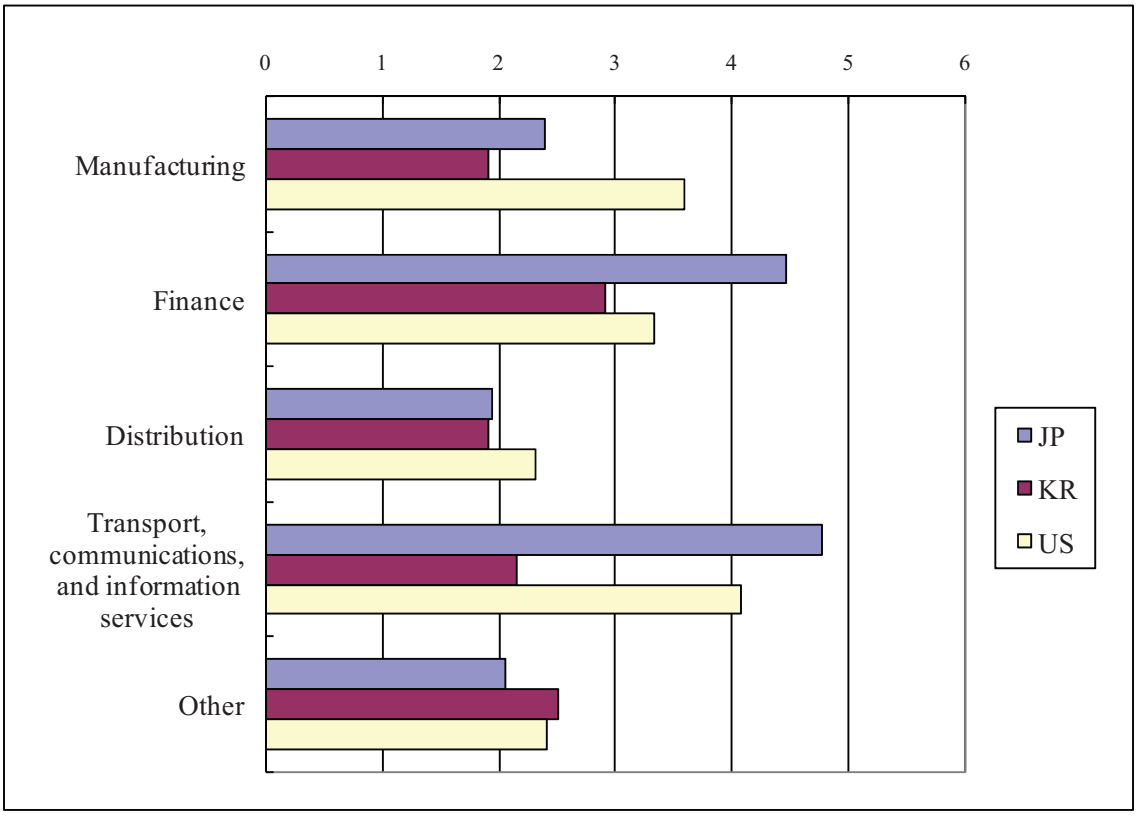
The survey was targeted for listed companies in Japan, the United States, and Korea. Therefore, the focus of the survey is to reveal how IT is being used for managerial strategies in relatively large firms. The topics of the survey was on "Deployment of IT systems," "The relation between IT investments and management strategies," "Internal IT Organization," and "Outsourcing of IT systems." The survey items of "Deployment of IT systems" include the level of deployment of IT systems classified by the type of business and how Enterprise Resource Planning (ERP) systems and Supply Chain Management (SCM) systems are implemented. "The relation between IT investments and management strategies" includes 12 items that the firm perceives as being important for its managerial strategy such as "Development of new products," and "Adjusting to market needs," and the contribution of IT systems to achieve these management goals is investigated. "Internal IT Organization" includes questions related to the role of CIO and the decision-making process of IT investments, and "Outsourcing of IT systems" surveys topics such as the relationship with the outsourcing partner firm and the type of businesses that are outsourced (Refer to RIETI(2007) for details).

The survey was conducted via the Internet and by mail for Japanese firms, and by phone for U.S. and Korean firms. Since the survey includes a number of questions regarding the corporate decision-making process of IT investments, the respondents were chosen to be executives of the firm that are in charge of corporate IT strategy or classes above the manager level of the IT division that has a large influence on the decision-making process of the executive in charge of IT strategy. In the cases that these chosen respondents could not be reached, the firm was dropped from the sample. The survey was conducted to listed corporations of Japanese, U.S., and Korean firms, and the industrial classification were manufacturing, distributors (retail, wholesale), financial sectors (banks, securities firm,

insurance), transportation/communications and information services (excluding transport), and others. In the telephone survey conducted in the U.S. and Korea, the sample was adjusted so that the industry distribution was approximately half manufacturing and the rest others.

Figure 1 shows the graph of the three country comparison classified by industrial classification of IT expenditure (including hardware, software, and system outsourcing fee) per sales.[1] In the U.S., the IT expenditure ratio is highest for manufacturing, commerce, and distribution sectors, whereas Japanese firms possess a high ratio for finance/insurance and information services industries. The IT expenditure ratio of Korean firms is lower in all industries except for others, and the level of IT intensity is lower compared with Japanese and U.S. firms.

Figure 1: IT expenditure/Sales ratio (%)



Results of the comparative analysis on it and management

In this section, a comparative analysis of Japanese, U.S., and Korean firms regarding IT and

[1] The survey questioned the IT investment ratio qualitatively as 1.Less than 1%, 2.Between 1%-3%, … The average was computed using 0.5% for less than 1%, 1.5% for Between 1%-3%, 4% for Between 3%-5%, 7.5% for Between 5%-10%, and 10% for Above 10%. The country ranking for each industry does not change even if we use 15% for Above 10%.

management is conducted using the survey data. The following descriptive regression model is used throughout in this section:

$$VAR = \alpha + \beta_1 dummyUS + \beta_2 dummyKR + \beta_3 dummyINDUSTRY + \beta_4 dummySIZE + \varepsilon \quad (1)$$

VAR is the variable of interest for the comparison of Japanese, U.S., and Korean firms, and the explanatory variables of the regression are U.S. dummy (Japan as the base category), Korean dummy (Japan as the base category), industry dummy (5 classifications on Table 1), and size dummy (5 classifications on Table 2). The variable of IT and management is affected by industrial classification and firm size. For example, inventory management is not an issue for firms in the financial sector, and large firms would naturally have a higher incentive to deploy complex IT systems. Equation (1) controls for these differences in the sample characteristics, in order to check the cross country differences statistically.

Deployment of IT Systems

First, Table 1 reports the results regarding the deployment of IT systems. Models 1 to 11 shows the results of the level of IT system deployment based on types of businesses (Probit), Model 12 is on ERP adoption (Probit), Model 13 is on complementary business process reform conducted in conjunction with the adoption of ERP (Multinomial Logit), Model 14 is on SCM adoption (Probit), and finally Model 15 is on the level of data linkage between ERP and SCM systems (Ordered Probit). The results of the regression for Equation (1) are shown in the table excluding U.S. dummy (β1) and Korean dummy (β2).

Table 1: Deployment of IT systems

		U.S.		Korea	
(1)	Personnel/wage management	−0.794	(3.96)**	−0.099	(0.45)
(2)	Accounting transactions	−0.025	(1.33)	−0.023	(1.27)
(3)	Internal information management/Document management	0.010	(0.23)	−0.063	(1.53)
(4)	Management strategy support	0.213	(4.48)**	0.054	(1.12)
(5)	Market analysis/Developing customers	0.252	(5.21)**	−0.025	(0.52)
(6)	Customer relationship management/Sales support	0.000	(0.01)	−0.050	(1.21)
(7)	Production planning/production process	0.131	(3.07)**	−0.006	(0.14)
(8)	Inventory management	0.039	(1.04)	0.001	(0.03)
(9)	Design support/Information manamgent of technology	0.168	(3.60)**	−0.105	(2.25)*
(10)	Ordering management	−0.028	(0.72)	−0.121	(3.02)**
(11)	Distribution management/Scheduling of product delivery	0.095	(2.04)*	−0.008	(0.17)
(12)	Adoption of ERP System	−0.007	(0.06)	0.380	(3.05)**
(13)	ERP Adoption (1)				
	Adjust business to ERP	0.740	(2.46)*	−0.554	(1.76)
	Adjust ERP to business	0.651	(2.16)*	0.395	(1.44)
(14)	Adoption of SCM system	−0.292	(2.33)*	−0.537	(4.10)**
(15)	Data Linkage of ERP and SCM (2)	−1.369	(3.66)**	−0.247	(0.57)

Note 1: The base category is "Adjust both business and ERP"
Note2: 1 (Perfectly collaborating) 2 (Partly collaborating) 3 (Independently run)
Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

First, regarding the deployment of IT systems based on the type of business, U.S. firms have a higher deployment ratio in areas such as "Management Strategy Support," "Market Analysis/Building Customer Relations," "Production Planning," "Planning Support/Information Management of Technology," and "Distribution Management," whereas the ratio is lower in "Personnel and Wage Management," compared with Japanese firms. In Korean firms, the deployment ratio is low in areas such as "Planning Support/Information Management of Technology" and "Ordering Management." Next, regarding the deployment of ERP systems, there is no statistical difference between Japanese and U.S. firms, whereas the deployment ratio is higher in Korean firms. Since an ERP system is a prepackaged software, it is necessary to customize the software as well as adjusting the firm's business process to match the software upon the deployment of the system. When deploying an ERP system, a higher portion of U.S. firms "Adjust the system to match business" or "Adjust business to match the system," whereas a higher portion of Japanese firms "Jointly adjust both system and business," and these differences regarding the choices of adjustments are statistically significant. Finally, as regard to SCM systems, the deployment ratio of U.S. and Korean firms are relatively lower compared with Japanese firms. However, the results reveal that the level of data linkage between ERP and SCM systems is higher for U.S. firms. Although SCM systems are being widely deployed in Japan, the results indicate that only relatively few firms are jointly utlizing with ERP systems to increase efficiency at the whole company level.

Management Strategies and the Contribution of IT

This section reports the results on management strategies and the contribution of IT. The survey first questioned whether there is an IT strategy (A medium to long-term (around 3 years) IT systems investment planning) or not, and its relation with management strategies. Model 1 in Table 2 shows the results of the estimates of a Probit model of whether there is an IT strategy or not, and Model 2 reports the estimates of a Multinomial Logit model regarding the relation between IT strategy and management strategy. First, there is no large difference in whether a firm has an IT strategy or not between Japanese and U.S. firms, but a higher portion of Korean firms have indicated that they do not have an IT strategy. As regard to the relation between IT strategy and management strategy, a large number of U.S. firms indicated that IT strategy vividly reflects management strategy, but at the same time, a high portion of firms responded that the link between these strategies is weak. In other words, Japanese firms' "IT Strategy is not stated vividly in its management strategy, but nevertheless matches its management strategy." In Korean firms, the proportion of firms that responded "There is a weak relationship between the two strategies" was higher compared with Japanese firms.

Table 2: Management Strategy and the Contribution of IT

		Importance as a management strategy			
		U.S.		Korea	
(1)	Whether there is an IT strategy	−0.047	(0.35)	−0.370	(2.93)**
(2)	The relation between IT and mangement strategies (Note)				
	Clear role in the management strategy	0.915	(2.10)**	0.596	(1.47)
	Weak relatation between the two strategies	2.102	(1.74)*	2.726	(2.40)**
	Importance as a management strategy				
(3)	New products, services, and businesses	0.062	(0.85)	0.103	(1.42)
(4)	Stregthening the competitiveness of core businesses	−0.134	(1.98)*	−0.100	(1.48)
(5)	Quick response to market needs	−0.144	(2.42)*	−0.044	(0.74)
(6)	Developing new customers	0.278	(3.93)**	0.066	(0.93)
(7)	Increasing customer satisfaction of present customer	0.124	(1.96)*	−0.166	(2.64)**
(8)	Market analysis/marketing	0.019	(0.30)	0.283	(4.51)**
(9)	Expediting product development	−0.121	(1.78)	−0.048	(0.71)
(10)	Enhancement of sales capability	−0.437	(6.56)**	−0.065	(0.97)
(11)	Cost reductions of back office divisions	−0.001	(0.02)	−0.276	(3.83)**
(12)	Inventory cost reductions	−0.082	(0.98)	0.015	(0.18)
(13)	Rearrangement of the supply chain	0.200	(2.42)*	0.242	(2.93)**
(14)	Internal information sharing	0.241	(3.18)**	−0.015	(0.19)
	Contribution of IT				
(15)	New products, services, and businesses	0.301	(4.53)**	0.118	(1.78)
(16)	Stregthening the competitiveness of core businesses	0.242	(4.11)**	0.146	(2.48)*
(17)	Quick response to market needs	−0.120	(2.04)*	0.203	(3.44)**
(18)	Developing new customers	0.063	(1.01)	0.032	(0.52)
(19)	Increasing customer satisfaction of present customer	0.098	(1.72)	0.124	(2.17)*
(20)	Market analysis/marketing	−0.038	(0.60)	0.150	(2.36)*
(21)	Expediting product development	0.104	(1.66)	0.067	(1.07)
(22)	Enhancement of sales capability	0.022	(0.36)	0.047	(0.77)
(23)	Cost reductions of back office divisions	−0.269	(3.87)**	−0.439	(6.25)**
(24)	Inventory cost reductions	−0.288	(4.14)**	−0.209	(3.00)**
(25)	Rearrangement the supply chain	−0.075	(1.03)	0.043	(0.60)
(26)	Internal information sharing	−0.069	(0.88)	−0.326	(4.17)**

Note: The base category is "Not clearly stated in the management strategy, but nevertheless consistent"
Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

To evaluate the contribution of IT to various types of management strategies, the respondent firms indicated the importance of the 12 types of management strategies, such as "Development of new products, services, or businesses" or "Strengthening the competitiveness in core businesses," and the contribution of IT to these management strategies on a 5-point scale. Since individual firms' responses to these subjective evaluations would cause biases for the regression, these response biases were first controlled. Each firm's average responded score was computed for the 12 types of questions that were surveyed, and the average score for each individual firm was subtracted from its responses for each of the 12 items in order to measure the distance from the average score. By applying this method, an index could be created for the individual firm's relative importance for each of the 12 surveyed items. In addition, this method also controls for the bias caused by firms that generally reported high scores and those that indicated low scores due to the subjective nature of the survey.

Equation (1) was estimated for the regression of the different types of management strategies of firms, but the variable indicating the importance of management strategy was also included

as an independent variable in the regression of the contribution of IT. As regard to the contribution of IT, the respondents were asked "How much do you think IT investments have contributed to each of the following items?" but it is natural for firms to respond low scores for the contribution of IT in items that the firm perceives as being a non-important management strategy. Therefore, in order to estimate the contribution of IT for each of the different types of management strategies, the degree of marginal importance of the specific management strategy should be controlled for in the regression. Finally, a Double Bind Tobit model was used for the regression, since the range of the dependent continuous variable[2] is -5 to 5.

First, the results of the importance of the different types of management strategies indicate that U.S. firms indicate that items such as "Development of new customers," "Increasing customer satisfaction of current customers," "Reconsidering the supply chain," and "Information sharing in the firm" are more important with respect to Japanese firms, whereas "Increasing the competitiveness of core businesses," "Responding to market needs," and "Enhanced sales ability" are lower in importance. For Korean firms, items such as "Market analysis/marketing" and "Reconsidering the supply chain" was indicated as being relatively important, whereas "Increasing customer satisfaction of current customers" and "Cost reductions of the indirect division" has been reported to be relatively low in importance. As regard to the contribution of IT to these different managerial goals in U.S. firms, the contribution is high for "Development of new products, services, or businesses" and "Strengthening the competitiveness in core businesses," whereas low contributions are reported for "Quick response to market needs," "Cost reductions of the indirect division," and "Reduction in inventory costs." In Korean firms, the contributions are high for "Strengthening the competitiveness in core businesses," "Quick response to market needs," "Increasing customer satisfaction of current customers," and "Market analysis/marketing," whereas the relatively low contributions are reported for "Cost reductions of the indirect division," "Reduction in inventory costs," and "Information sharing in the firm," compared with Japanese firms. These results indicate that Japanese firms report a high contribution for cost reductions, such as "Cost reductions of the indirect division" and "Reduction in inventory costs," whereas the contribution is low in areas that relate to increased sales, such as "Development of new products, services, or businesses" and "Increasing the competitiveness of core businesses."

Internal IT Organization

[2] More precisely, it is a discrete variable with intervals of length 1/12, but it is thought be reasonable to approximate it as a continuous variable.

In this section, the results regarding the Internal IT organization of the firm, such as the role of the Chief Information Officer (CIO) or the relation between the IT division and the IT-user divisions, will be presented. Table 3 presents the results of the regression analysis. Model 1 is whether there is a CIO or not (Probit), Model 2 is whether the CIO is a full-time executive or not (Probit), and Model 3 reveals the career of the CIO (Multinomial Logit model with "from the IT division" as the base category). First, there is no statistical difference on whether there is a CIO (defined as an executive in charge of IT systems) or not between Japan and the U.S., but less Korean firms report of having a CIO. The results indicate that a larger portion of U.S. firms have full-time CIO's who are in charge of IT systems compared with Japanese counterparts, and the difference is statistically significant. With regard to the past career of the CIO, U.S. firms report that a low portion of CIOs' careers are from divisions such as general affairs and finance, and a high portion of CIO's are recruited from outside. In Korean firms, there is a low proportion of CIO's from the business division.

Table 3: Internal IT Organization

		U.S.		Korea	
(1)	CIO or no CIO	−0.004	(0.09)	−0.101	(2.10)*
(2)	Whether the CIO is a full-time executive	0.381	(5.88)**	0.053	(0.73)
(3)	Career background of the CIO (Note 1)				
	From the management planning division	−0.632	(1.71)	−0.082	(0.26)
	From the general affairs/finance divisions	−1.488	(3.06)**	−0.603	(1.66)
	From the business operation division	0.146	(0.36)	−1.082	(2.19)*
	Recruited from outside	3.036	(5.63)**	0.909	(1.47)
	Importance of the duty as the CIO				
(4)	Internal cordinations of IT systems	0.032	(0.48)	0.141	(2.05)*
(5)	Planning new servicess	−0.145	(1.95)	−0.001	(0.02)
(6)	Business process reform	−0.046	(0.66)	−0.133	(1.88)
(7)	Grasping the trends of cutting-edge technology	0.098	(1.54)	0.077	(1.18)
(8)	Choosing outsourcing firms	−0.426	(5.41)**	0.118	(1.45)
(9)	Running the system stably/security	0.204	(3.06)**	−0.057	(0.84)
(10)	Analyzing the effects of deployed systems	0.068	(1.20)	−0.034	(0.59)
(11)	Promoting internal information sharing	0.208	(3.10)**	−0.112	(1.62)
	Relation between the IT division and the IT-user divisions (Note 2)				
(12)	Allocating IT staffs	−0.142	(1.29)	−0.206	(1.86)
(13)	Proposing new systems	−0.144	(1.35)	−0.509	(4.70)**
(14)	Designing new systems	0.167	(1.55)	−0.306	(2.75)**
(15)	Deciding the IT budgets	−0.080	(0.74)	−0.379	(3.37)**
(16)	Quantifying the effects of IT investments	0.128	(1.19)	−0.379	(3.44)**

Note 1: The base category is "from the IT division."
Note 2: 3 levels of choices for this quesion: 1 (IT division is important), 2 (Equally important), 3 (user division is important).
Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Models 4-11 present the results of the importance of the duties of the CIO. 8 types of work conducted by the CIO and the importance of these duties were evaluated on a 5-point scale. In order to mitigate the response bias due to the subjective nature of the questionnaire, the scores for each of the 8 types of duties were subtracted from the average score of importance for all the duties, and this computed value was used as the dependent variable in Equation (1)

for the Double Bind Tobit model. First, compared with Japanese firms, U.S. firms indicate "Stable operation of the system/security" and "Facilitating information sharing of the firm," as being highly important, while "Selecting outsourcing firms" is perceived to be of low relative importance. Not much difference is found between Japanese and Korean firms, but "Adjustment of IT systems of the firm" is more important in Korean firms. Finally, Models 12-16 is an Ordered Probit model that compares whether the IT division or the IT-user divisions is in position to exercise leadership in Japanese, U.S., and Korean firms for different types of businesses. There are no statistical differences between Japanese and U.S. firms, but Korean firms have indicated that the IT division has the initiative in a number or categories such as "Proposal of new systems" and "Planning new systems."

Discussions

A detailed survey regarding IT-use and the effects of IT investments by Japanese firms is conducted by the Japanese Ministry of Economy Trade and Industry's (METI's) ICT Workplace Survey. The results of this survey indicate that Japanese firms have been successful in increasing the effectiveness of its businesses by introducing accounting information systems or reducing inventory costs by implementing inventory management systems, but only a small portion of firms have been able to use IT to increase sales, for example by developing new customers (METI, 2005).

Referring back to the results regarding the differences in the types of areas that IT systems are deployed in Japanese and U.S. firms, the ratio of system deployment of Japanese firms is high in areas directed towards back office divisions such as personnel/wage management, whereas deployment is behind in "Informational systems" such as managerial strategy support, market analysis/developing new customers, design support/information management of technology. "Mission critical systems," or systems that increases efficiency of daily business operations such as management of ordering and systems for the back offce divisions, are a typical type of system that rationalizes business processes. This type of IT-use has been implemented since the advent of general-purpose computers in the 1970's and is a classical way of IT-use by firms. On the other hand, recently there is great attention in using "Informational systems" to perform intricate analysis regarding management decision-making and market analysis using data collected by the "Mission critical systems." The idea of using information systems to facilitate managerial strategies has been around since the 1970's, exemplified by concepts such as Management Information Systems (MIS) and Decision Support Systems (DSS), but it is in the 1990's that these systems became of practical use due to the sharp increase of memory and processing capability of computers. Data warehouses have been created in order to integrate information that has previously been

dispersed around the firm, and data mining techniques have enabled firms to extract critical information from the data warehouse to facilitate corporate strategy. Since the 2000's, the concept of Business Intelligence (BI) has been put forward to offer a user-friendly environment and enable access to non IT specialists of the management and planning divisions of the firm.

The results of the contribution of IT systems to corporate strategy of Japanese and U.S. firms are also consistent with the differences in the area of IT system deployment. In Japanese firms, the positive effects are relatively large in areas related to mission critical systems, such as "Cost reductions of the indirect division" or "Inventory cost reductions," whereas the type of benefit realized in U.S. firms are related to informational systems, as indicated by effects such as "Development of new products, services, and businesses" or "Strengthening the competitiveness of core businesses." Now, Japanese firms have revealed a positive effect for "Quick response to market needs," but this effect could correspond to either an effect by mission critical systems due to operational benefits, such as quick responses, realized by intimate collaboration with partner firms, or informational systems due to increased speed of product development to meet consumer needs. As Table 1 indicates, Japanese firms are relatively ahead in deploying Supply Chain Management (SCM) systems, but behind in areas related to new product development such as facilitation of design and information management of technology, so the positive effects of "Quick response to market needs" more likely represents benefits by mission critical systems.

Compared with Japanese firms, the ratio of SCM system adoption in U.S. firms is low, but there is a stronger collaboration with Enterprise Resource Planning (ERP) systems in firms that are deploying SCM systems. SCM systems enable firms to increase operational efficiency of ordering, production planning, and inventory management for the line of product that SCM is used, but whether this information will be shared at the firm-wide level depends on the collaboration with ERP systems. If SCM systems are deployed alone, efficiency will increase for the specific line of product or a particular division of the firm, but it is not possible to use this information for corporate decision-making or to develop new areas of business. This result provides further evidence that Japanese firms' IT investments are geared towards operational aspects to increase efficiency of business, but IT is not often used to facilitate management's decision-making which leads to strengthening the competitiveness of the firm.

What are the characteristic features of Korean firms? Japanese firms have invested heavily in IT since the 1980's, and there is a relatively long history of IT system deployment, but the surge of IT investments by Korean firms started in the 1990's (Kanamori and Motohashi,

2007). Having a relatively short history of IT adoption has some merits and detriments. On the positive side, there are no legacy systems, such as mainframe computers or interorganizational networks based on private lines. Japanese firms have incurred a large cost in the legacy migration process, to transit from applications implemented on old systems to new, open systems, using client/server machines and the Internet, but Korean firms do not have to worry about this burden. On the other hand, Korean firms do not have the stock of skills needed for different areas of businesses and information literacy of employees which is needed to effectively use IT systems for management.

Looking at the results of Table 1 with this background in mind, Korean firms are behind Japanese firms in deploying IT in areas such as "Design support/information management of technology" and "Ordering management." The adoption of SCM systems is also behind indicating that IT is not being utilized in areas related to the actual business operations, such as the planning division and factories. However, the ratio of ERP adoption is high. ERP software is a type of system that unifies and manages information of different types of activities of the firm, such as personnel/wage, ordering, and inventory management, and Korean firms are active in the unification and management of the firm's internal information. The contribution of IT are high in areas such as "Strengthening the competitiveness of core businesses," "Quickening responses to market needs," and "Increasing satisfaction of current customers," and low contributions are reported in areas such as "Indirect cost reductions" and "Inventory cost reductions." Compared with Japanese firms, the results of Korean firms are similar to U.S. firms in that the reported contributions are high in areas that use informational systems to achieve these benefits. However, compared with Japanese firms, Korean firms' IT strategy and managerial strategy are not consistent, implying that most likely, a relatively high portion of Korean firms reported positive effects from informational systems since there is only a limited amount of stock regarding the effective use of mission critical systems. It is important to note once again that the contribution of IT in this study is measured relative to the evaluations of the 12 surveyed items.

Next, we turn to the IT organization of the firm, which supports the use of IT systems by the firm. In order to use IT not only as a tool to rationalize individual daily businesses but also as a tool to implement corporate strategy, the role of the Chief Information Officer (CIO) becomes important. Firms that do not have CIO's are indicative of having a low concern for the strategic use of IT. The ratio of firms that have CIO's (executive class) is approximately the same in Japanese and U.S. firms, but it is a little low in Korean firms. The head of the IT division of most Korean firms are not executives, and there is a relatively low perceived importance in linking IT systems with corporate management in Korean firms.

Compared with Japanese firms, there is not much difference in the ratio of whether there is a CIO or not in U.S. firms, but there is a big difference in the position and role of the CIO. In Japanese firms, CIO's hold joint appointments in non-IT related divisions that are responsible for business operations, whereas a higher portion of U.S. firms have CIO's with full-time positions. As regard to the background of the CIO's, a large portion of Japanese CIO's come from the general affairs/finance division whereas a high proportion of U.S. CIO's are recruited from outside. With regard to the importance of the type of job involved, a large number of Japanese firms responded that "Choosing the outsourcing firms" is important, while a higher number of U.S. firms indicated that "Running the system stably/security" and "Promoting information sharing in the firm" as important priorities. As these results indicate, the CIO in U.S. firms is regarded as an independent post and specialists are recruited from outside the firm to run the IT systems stably and focusing on fundamental areas of the job such as facilitating information sharing in the firm. In contrast, CIO's in Japanese firms often hold joint appointments with other divisions related to general affairs or finance, and the role of the CIO is rather ambiguous compared with U.S. firms.

As pointed out earlier, the ratio of CIO's in Korean firms is low compared with Japanese firms, and the firms' awareness for IT systems and its relation to corporate management is pretty low. As regard to the background of the CIO, there is no category that is statistically significant implying that the ratio of the base category, which is originally from the IT division, is high. As regard to the important duty of the CIO, many firms responded that internal adjustments of IT systems as a priority. In addition, a key feature regarding the relation between the IT division and the user division of the firm is that the IT division takes the initiative for most of the surveyed categories including proposals of new systems, planning, and deciding IT budgets. In Korean firms, since IT specialists are involved in internal system deployment independently, chances are pretty low that there is a clear vision in effectively using IT for management at the corporate level. Summarizing the points indicated regarding the results, it may be said that U.S. firms' perception for the importance of incorporating IT systems for corporate strategy is the highest, followed by Japanese firms, and finally by Korean firms.

The reason for a large number of Japanese CIO's to hold joint appointments in other departments and Japanese firms to begin outsourcing before the terms of the outsourcing activity are clearly stated is highly related to the characteristics of the Japanese firm and its surrounding economic institutions. Aoki (1986) conducted an analysis of the comparative advantages of different types of organizational forms, using a 2 division model of the management and its subordinate organization. In this analysis, in addition to the information that affects the entire firm (system shock), sharing of the information that affects individual divisions (individual shock) across the different divisions of the firm depends on the

complementarity of the types of work of the different divisions and the size of the relative weight of the individual shock with respect to the system shock. It is said that sharing information of the individual divisions across the divisions in addition to the firm-wide information (a horizontal hierarchical system) is complementary with Japanese economic institutions (tacit rules), which includes a stable employer and employees relations and a long-term relationship with trading partners. On the other hand, the pattern of organization (distributed information system) that does not share division-specific information (the type that operates using firm-wide information and information of its own division only) is complementary with the U.S. economic institutional system where there is an active flow of human resources and funds through the channel of external markets (Aoki and Okuno, 1998).

The results of this study revealed that U.S. firms often recruit specialists as CIO's from outside, utilizing the active external labor market. Therefore, it is natural for firms to clarify the qualifications of the CIO and their role in the firm beforehand, and offer them full-time positions to perform their duty. On the other hand, CIO's in Japan are often appointed from within the firm, and the CIO often has other job duties as well. In the previous model, if we treat the management division as the CEO and the two subsidiary divisions as the IT division and the IT-user division, it could be thought that the IT division of U.S. firms is run independently, led by the CIO, as an information distributed system, whereas the form of Japanese firms is close to a horizontal hierarchy system, with a higher degree of coordination between the divisions. Communication of tacit information and reaching of agreements is possible since interdivisional communication based on specific contexts forms, due to the long-term employment conditions. Japanese firms jointly appointing CIO's with other executive positions indicates the low perception of the role of IT for corporate management in Japanese firms, but at the same time, it could also be interpreted as an attempt to reform business processes using IT, together with the actual divisions that are operating business.

However, since the responsibilities of the IT division and the IT-user divisions is ambiguous in the Japanese firm system, there is potentially a risk of the adjustments costs becoming very high if there are inconsistencies in the tacit agreements that were reached between the divisions. In addition, since conducting interdivisional communication inevitably slows down the flow of information and the decision-making process, it becomes difficult to effectively use state of the art IT systems and obtain good results (Motohashi, 2006). The reason that the use of "Informational systems" in Japanese firms is behind those of the U.S. could be associated with the active interdivisional communication seen in Japanese firms. Since information sharing was already active, the incentive to "visualize" the internal movements of the firm using IT is low. However, due to the increased intensity of global competition and the complexity of business domains, it is increasingly important to execute corporate

decisions based on a wider information base. Due to these changes in the environment, the risk of using internal tacit information as the source for corporate decision-making is increasing. Therefore, it may be that Japanese firms have to incorporate some aspects of "Information distributed systems" regarding IT-use, in order to expedite the information flow of internal, explicit knowledge. On the other hand, U.S. firms are increasingly using IT effectively as an information sharing tool of the firm. The results revealing the importance of "Internal information sharing" as a CIO's duty is consistent with these trends of U.S. firms.

CONCLUSION

In this paper, a comparative analysis regarding IT use and the contribution of IT to management strategies was conducted for Japanese, U.S. and Korean firms using the data of the "International Comparative Survey of Firms' IT Strategies" (RIETI). The results reveal that, in Japanese firms, the effects of IT are large for "Mission critical systems," systems that increase the efficiency of daily business operations such as personnel, wage, accounting, and ordering management, whereas U.S. firms are using "Informational systems," systems that performs complex analysis using the firm's data such as managerial strategy support, market analysis, and new customer development systems. In Korean firms, the deployment of IT is generally behind Japanese firms with the exception of ERP systems.

With regard to the internal IT organization which is a key in promoting the use of IT systems in firms, U.S. firms' CIO's have a full-time position with a clear role including running the system stably and facilitating internal information sharing, whereas Japanese CIO's often have a career experience in the general affaris/finance divisions and are jointly appointed with other positions. In addition, it is found that a large portion of Korean firms do not have executives in charge of IT. Therefore, U.S. firms has the highest awareness of using IT as a strategic tool to improve corporate management, followed by Japanese firms, and finally by Korean firms.

One caveat to keep in mind is that this analysis compared the use of IT systems in the three countries, but does not address which country's method is better than the other. Therefore, the most important direction of future research is to perform an analysis to find the relation between the IT-use of firms and firm performance. Korean firms have a relatively short history of IT-use, and the deployment of IT systems is generally behind those of Japanese and U.S. firms. Referring to the portion of firms that have CIO's, it is not likely that Korean firms have the perception of utilizing information systems as a strategic tool. However, the IT investment ratio at the macroeconomic level is increasing sharply to Japanese levels (Kanamori and Motohashi, 2007), and there is a possibility of Korean firms to rapidly

improve their management of IT by using their strength of not possessing legacy systems. The results also indicate that there is big difference in the method of IT management comparing Japanese and U.S. firms. The background economic institutional differences (tacit rules regarding the law and economic transactions) in these two countries may be one reason for these results. There may be an advantage for the U.S. firm system to effectively use IT, due to the swift technological process in this field, but we would like to analyze and examine whether the Japanese or U.S. system has a comparative advantage regarding IT management and firm performance.

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EFFECTS OF KNOWLEDGE INTEGRATION AND TASK-TECHNOLOGY FIT ON THE IMPLEMENTATION OF E-BUSINESS APPLICATIONS: EVIDENCE FROM TAIWANESE SERVICE INDUSTRY

Dr. Jung-Chi Pai, Takming University of Science and Technology, Taipei, Taiwan
rogerpai@mail.takming.edu.tw

ABSTRACT

As the rapid progress of network and internet, "how to implement innovative e-business applications effectively?" has been consistently identified as one of the most critical issues facing academic researchers of information management as well as business managers in the network era. Numerous researchers have proposed various studies relating to development and implementation of e-business applications. However, the effects of knowledge integration and task-technology fit on the implementation of e-business applications in service industry still have little been examined.

The main purpose of this study is to examine the effects of knowledge integration and task-technology fit on the implementation of e-business applications. Data were collected by a questionnaire survey sent to 1000 large service enterprises in Taiwan. Of the 1000 questionnaires distributed, 239 were returned, for a response rate of 23.9%. However, 44 respondents indicated that they did not implement any e-business applications in their organizations, and thus 195 completed usable questionnaires were used to perform the statistical analysis. The survey results indicate that knowledge integration and task-technology fit influence the implementation process of e-business applications, as well as the implementation process of e-business applications influence the implementation effectiveness of e-business applications. The implications of the findings for IT practice are discussed. Moreover, this study will provide a valuable reference for business and IT managers who are implementing e-business applications in the network era, and for researchers interested in the development of e-business applications.

Keywords: E-business applications, Knowledge integration, Task-technology fit, Service industry

INTRODUCTION

As the rapid advances in information technology and internet applications, the implementation of e-business application is widely viewed as an effective means of enhancing competitive advantages. It has consistently been identified as one of the most critical issues facing information systems executives and researchers (Chuang and Shaw, 2005; Cagliano *et al*., 2005; Daghfous and AI-Nahas, 2006; Eikebrokk and Olsen, 2007; Eze, 2008). The core applications of e-business includes enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), as well as knowledge management (KM). Enterprise resource planning (ERP) is a tool that helps companies cut costs and improve efficiency by integrating business processes and sharing common resources across an organization (Zheng *et al*., 2000). ERP systems offer tremendous opportunities to more consistently provide information to organizations in a standardized, centralized, and cost efficient manner (Olson *et al*., 2005). Supply chain

management deals with the coordination of companies along the entire supply chain that brings raw material from its source of supply through different value-adding activities ultimately to the customer (Zhang and Li, 2006). Kalakota and Robinson (2001) contended that CRM can be seen as the consistent organization activity under the using of integrated selling, marketing and service strategy. CRM is about acquiring customers, knowing them well, providing services and anticipating their needs (Goodhue and Wixdom, 2002). Knowledge management systems generally support three types of activities: generation, codification and utilization of knowledge (Davenport and Prusak, 1998). Organizations can achieve enormous benefits by implementing KMS such as better customer service, productivity, staff morale (Davenport and Prusak, 1998; Alavi and Leidner, 1999; Yates-Mercer and Bawden, 2002). According to the report issued by Directorate-General of Budget, Accounting and Statistics of Executive Yuan in 2007 pointed out that the GDP of service industry is 72.91% in Taiwan, working population counts to 5.91 million. As a result, service industry is crucial to the economic development of Taiwan.

In recent years, much empirical research has been conducted in the area of e-business in recent years. For example, Li and Chang (2004) proposed a conceptual framework for e-business strategy. They further argued that the framework must be holistic, dynamic and dialectical. Koo *et al.* (2007) examined the influences of environmental factors on e-business performance. Lin (2008) examined the impacts of innovation characteristics and organizational learning capabilities on e-business implementation success. However, seldom empirical research that focused on service industry has been conducted from the perspectives of knowledge integration and task-technology fit. As the rapid progress of information technology and information systems applications, there are numerous firms in service industry have implemented innovative e-business applications to enhance their competitive advantages and achieve the business goals. This study investigates the knowledge integration and task-technology fit that influence the implementation of e-business applications. The hypothesized relationships were empirically tested using a field survey of large service firms in Taiwan. The results of this study will be of interest to business managers and information systems executives of service industry who are initiating or implementing e-business applications, and to researchers in the field of information management and e-commerce/e-business.

THEORITICAL BACKGROUND

With the rapid progress of information and network technology, more and more enterprises have implemented innovative e-business applications to enhance their competitive advantage. The implementation of e-business applications has been widely considered as an innovative means for contemporary organizations to improve their operational efficiency and enhance their competitive advantages (Butler, 2000; Clegg *et al*., 2001). Phan (2001) indicated that despite the many spectacular e-business successes, there have also been numerous failures. Bai and Lee (2003) further indicated that some companies fail not for technical reasons related to e-business implementation, but rather because they neglect the effects of organizational context on e-business implementation. Introducing an e-strategy may impact on various organizational perspectives, such as culture, skills, styles, structure, and beliefs, as well as various social and political perspectives (Bai and Lee, 2003).

Numerous empirical studies that have been conducted in the area of e-business, such as Chuang and Shaw (2005) combined interviews, case studies and an survey to determine the

significant factors leading to successful implementation of e-business applications, they suggested an implementation roadmap using four stages for implementing e-business systems: planning, developing, implementing, and testing. Eikebrokk and Olsen (2007) conducting an empirical study that investigated the competency factors affecting e-business success in European SMEs. Lee *et al.* (2007) examined the influence of organizational capabilities on e-business implementation success in Taiwan, the results showed that certain factors related organizational learning and knowledge management capabilities are key determinants of e-business implementation. However, there has been little empirical research that investigates the effects of knowledge integration and task-technology fit on the implementation of e-business applications.

RESEARCH MODEL AND HYPOTHESES

The research model was constructed based on a literature review, (refer to Figure 1), utilizing information systems management, knowledge management and organizational theory as reference disciplines. Furthermore, this study also uses previous works of Grant (1996) and Roman *et al.* (2006) as a basis for developing the research model.

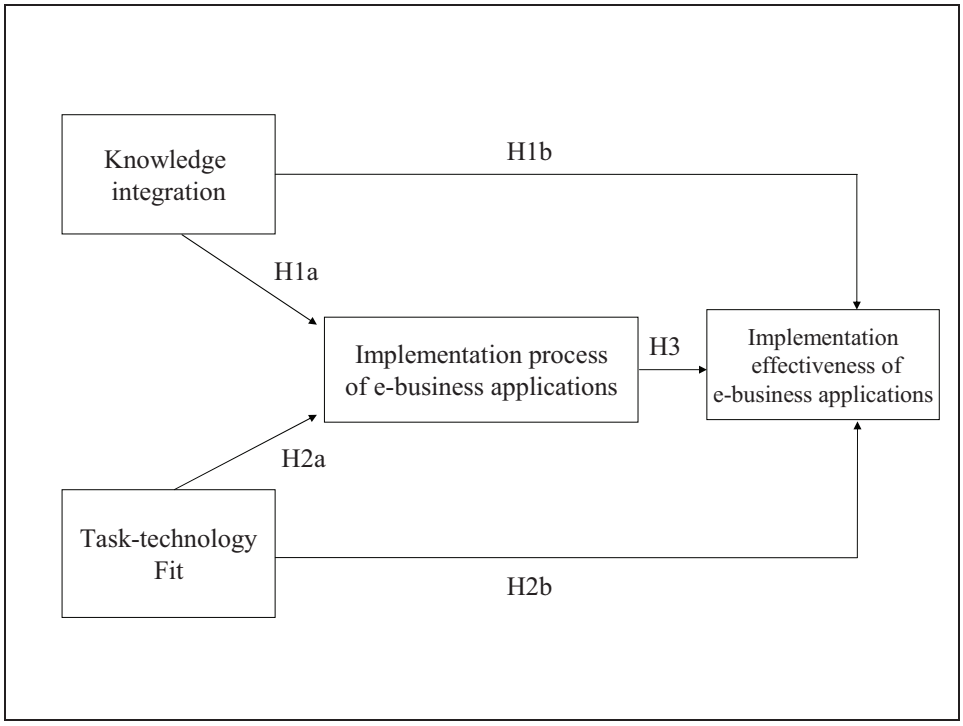

Figure 1. Research model

There are two dimensions of knowledge in organizations: The process is a cyclical process consisting of technology-centered strategy to manage explicit knowledge and people-centered strategy to manage tacit knowledge (Nonaka, 1994; Hansen *et al.*, 1999). Knowledge has emerged as the most strategically-significant resource of the firm, integration of specialist knowledge to perform a discrete productive task is the essence of organizational capability (Grant, 1996a). The benefit of knowledge integration is in meshing the different specialized knowledge of different individuals (Grant, 1996b). Mitchell (2006) indicated that integrative capability is important to large-scale information projects. During the implementation of e-business applications, four types of knowledge must be integrated, including business

process, organizational-specific knowledge (such as finance, production, distribution etc.), IT/IS knowledge and management competences. Such knowledge may be "tacit" or "explicit" (Nonaka, 1994). To achieve the objectives of e-business implementation, knowledge integration is necessary to the implementation of e-business applications. Therefore, the following hypotheses are proposed：

H1a：*Knowledge integration significantly and positively affects the implementation process of e-business applications.*
H1b：*Knowledge integration significantly and positively affects the implementation effectiveness of e-business applications.*

Tasks are dimension can be narrowed down to non-routineness and interdependence, thus it is defined as the actions carried out by individuals in turning inputs into outputs (Goodhue and Thompson 1995), they argued that technology features that are well aligned with tasks would consistently lead to better utilization of technology and subsequent performance improvement. Task-technology fit is the degree to which a technology assists an individual in positioning his or her tasks (Goodhue and Thompson, 1995). Speier and Venkatesh (2002) indicated that task-technology fit is necessary for the successful execution of CRM. Roman *et al*. (2006) also suggested that the match between the task and the technology is essential for successful CRM implementation. This match can be achieved through customization of the package and through adequate training. As task-technology fit is important to the implementation of e-business systems. Therefore, the following hypotheses are proposed：

H2a：*Task-technology fit significantly and positively the implementation process of e-business applications.*
H2b：*Task-technology fit significantly and positively affects the implementation effectiveness of e-business applications.*

The effect of implementation process of IS/IT applications on implementation effectiveness of IT/IS applications has been examined in previous works. Since e-business application are the main types of IT/IS applications in the network era. Therefore, the following hypothesis is proposed：

H3：*The implementation process of e-business applications significantly and positively affects the implementation effectiveness of e-business applications.*

RESEARCH METHODOLOGY

Sample and Data collection

The sample adopted was the Corporate 5000 from a business directory published by the China Credit Information Service, Ltd. in Taiwan. This directory includes top 5000 largest manufacturing, service and banking companies in Taiwan. We selected the top 1000 service companies from the business directory. Questionnaires were mailed to the information systems executives of 1000 service firms. A cover letter explaining the study objectives and a stamped return envelope were enclosed. The decision to use the IS executives as informants herein is supported by previous research conducted by Pai and Yeh (2008).

Measures Development

From the literature on organizational and information systems management theory, this study adopted variables that have been used and validated by other researchers. The research variables were defined as briefly as possible using multiple indicator items. Knowledge integration was measured using seven items amended from the works of Grant (1996) as well as Katz (1996) to make them relevant to the context of the implementation of e-business strategies. Task-technology fit was measured using the approaches developed by Goodhue (1995) as well as Klopping and McKinney (2004). Besides, the implementation process of e-business applications using five items was amended from the work of Ying and Wang (2007). Finally, a seven-item measure taken from the works of Chen and Chuang (2003) as well as Plant *et al.* (2003) were used to assess the implementation effectiveness of e-business applications. All variables were measured with multiple items on a five point Likert-type scale, ranging from (5) strongly agree to (1) strongly disagree.

Pre-testing

The questionnaire was refined through two rounds of rigorous pre-testing. The pre-testing process focused on instrument clarity, question wording and validity. During the first round of pre-testing, two MIS doctoral candidates and two MIS professors were interviewed. The construct measures were revised based on the comments of these four individuals. During the second round of pre-testing, a revised questionnaire was pre-tested by three senior IS executives involved in service industry. Each of these IS executives was actively involved in implementing e-business applications and had significant experience in IS management. The IS executives were given the questionnaire and asked to examine it for meaningfulness, relevance, and clarity.

DATA ANALYSIS AND RESULTS

Sample Characteristics

Of the 1000 questionnaires distributed, 195 completed usable questionnaires were returned, for a response rate of 19.5%. The respondents are all information systems executives, and had worked in the information systems field for an average of 14.3 years. Their job titles showed them to be generally at fairly high levels in their organization, and thus their views of the implementation of e-business applications are of great interest. The respondents came from diverse service industries, including banking/insurance, retail/wholesale/general merchandise, food/restaurant, transportation, information, design and other service industry (such as healthcare, publishing, distribution, hotel/travel and telecommunication) . This result implies that the implementation of e-business applications is carried out in a wide variety service firms.

Reliability and Validity of Research Variables

Internal consistency (Cronbach's alpha) was calculated in order to assess the reliability of all constructs (refer to Appendix A). As shown in Table 1, the results in our study indicate that all the constructs are greater than 0.7. The constructs are therefore considered to exhibit adequate reliability (Nunnally, 1978).

Factor analysis of the items comprising each construct determined the construct validity. Principal component factor analysis with VARIMAX rotation (refer to table 2) determined if all items measuring a construct cluster together, and selection of factors with eigenvalues greater than one. Subsequent analyses did not cover items with loadings of less than 0.5 on any factor. Factor analyses results for independent variables confirm that each construct is distinct from other constructs.

Table 1. Reliability coefficient of research variables

Variables	Number of items	Cronbach's α
Knowledge integration	7	0.85
Task-technology fit	9	0.94
Implementation process of e-business applications	5	0.90
Implementation effectiveness of e-business applications	7	0.91

Table 2 Factor Analysis (Varimax Rotation)

Factors	Acronym	Communalities	Factor1	Factor2	Factor3	Factor4
Task-technology fit	*TATF1*	0.712	0.782			
	TATF2	0.719	0.769			
	TATF3	0.710	0.758			
	TATF4	0.707	0.725			
	TATF5	0.692	0.700			
	TATF6	0.629	0.689			
	TATF7	0.711	0649			
	TATF8	0.736	0.603			
	TATF9	0.711	0.595			
Organizational performance	*ORPE1*	0.786		0.798		
	ORPE2	0.726		0.733		
	ORPE3	0.641		0.719		
	ORPE4	0.552		0.679		
	ORPE5	0.708		0.674		
	ORPE6	0.610		0.623		
	ORPE7	0.691		0.576		
Implementation process	*IPEB1*	0.702			0.700	
of e-business applications	*IPEB2*	0.757			0.687	
	IPEB3	0.704			0.666	
	IPEB4	0.664			0.582	
	IPEB5	0.589			0.569	
Implementation	*KNIN1*	0.593				0.720
effectiveness of e-business	*KNIN2*	0.699				0.716
applications	*KNIN3*	0.566				0.700
	KNIN4	0.560				0.650
	KNIN5	0.559				0.612
	KNIN6	0.467				0.582
	KNIN7	0.555				0.520
Eigenvalue			13.848	1.780	1.735	1.091
Variance explained			49.457	6.357	6.197	3.896

Note: Only factor loadings greater than 0.5 are shown.

Hypothesis Testing

The hypothesized relationships depicted in research model (Figure 1) were testing using multiple regression analysis. Table 3 summarizes the hypothesis tests. This table reveals no apparent colinearity problem among independent variable, as the variance inflation factors (VIF) for all independent variables are smaller than three (Neter *et al*., 1997).

A discussion on the results related to the research hypotheses follow. This study first examined the relationship between knowledge integration and the implementation process of e-business applications as well as the relationship between knowledge integration and the implementation of e-business applications. As predicted by H1a, knowledge integration significantly and positively affects the implementation process of e-business applications (β=0.299, p<0.001, t=6.001). Moreover, knowledge integration significantly affects the implementation of e-business applications (β=0.580, p<0.001, t=11.628), supporting H1b.

As proposed H2a, task-technology fit shows a positive relationship with the implementation process of e-business applications (β=0.275, p<0.001, t=4.626). Consequently, H2a is supported. Moreover, H2b is supported since the task-technology fit has a significant positive effect on the implementation of e-business applications (β=0.499, p<0.001, t=8.400). Finally, the implementation process of e-business applications has a strong significant effect on the implementation of e-business applications, so H3 (β=0.727, p<0.001, t=16.290) is supported.

Table 3. Results of Hypotheses Testing

Hypothesis ***(Direction)***	**Path**	**β Coefficient**	**t-value**	**VIF**
H1a (+)	Knowledge integration ➔ Implementation process of e-business applications	0.299	6.001***	1.656
H1b (+)	Knowledge integration ➔ Implementation effectiveness of e-business applications	0.580	11.628***	1.656
H2a (+)	Task-technology fit ➔ Implementation process of e-business applications	0.275	4.626***	1.656
H2b (+)	Task-technology fit ➔ Implementation effectiveness of e-business applications	0.499	8.400***	1.656
H3 (+)	Implementation process of e-business applications ➔ Implementation effectiveness of e-business applications	0.727	16.290***	1.000

Note: * p<0.05, ** p<0.01, *** p<0.001

CONCULSIONS AND FUTURE RESEARCH

Based on the empirical results of this study, this study has some important implications for practitioners who are implementing e-business applications. First, business managers or information systems executives of enterprises should consider knowledge integration when

implementing e-business applications (such as ERP, CRM, KMS or SCM). Second, given the importance of task-technology for the implementation of e-business applications, methods of improving task-technology fit must be considered. This study has the following limitations. First, while the subjects are information systems executives and managers of service firms in Taiwan, yet cultural differences may exist between Taiwan and other countries. Second, besides the competency factors considered in this study, numerous other organizational factors may also affect the implementation of e-business applications, and future research should consider more general competency factors.

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Understanding the mass adoption of third generation mobile communications system in Taiwan

Weichen Teng, Chinese Culture University, Taiwan
wcdeng@sce.pccu.edu.tw
Hsi-Peng Lu, National Taiwan University of Science and Technology, Taiwan
hsipeng@cs.ntust.edu.tw

ABSTRACT

Exciting innovations in mobile communications technologies have emerged in recent years, but not all of them have been accepted by the mass market. Because telecommunication businesses receive a return on their investments only when their products are accepted by the mass market, it is important for marketers and managers in the information and communications technologies industry to understand consumers' technology-adoption behavior. The study proposed that the mass adoption of a new generation mobile communications system involves constructs of adopting a new technology, services, and handset. A structural equation model was applied to test the hypotheses on a population of potential adopters in Taiwan. The results showed that the perceived utility of technology and services influence the consumer's adoption intention of an innovative system, while the enhancement of hedonic functionality and the design of the handsets increase some consumers' purchase intention. The results of this paper offer telecommunications policy makers, businesses, and researchers valuable insights into the factors influencing the mass market's adoption of mobile communications technologies.

Keywords: technology acceptance, consumer behavior, mobile communications technology

INTRODUCTION

Because of the significant increase in innovative information and communications technologies (ICTs) over the past decades, mobile communications technologies have evolved quickly and produced several different systems, such as the Global System for Mobile Communications (GSM), Wireless Application Protocol (WAP), General Packet Radio Service (GPRS), and Code Division Multiple Access (CDMA). Although third-generation communications systems (3G) have not replaced second-generation (2G) systems in most areas of the world, further fourth-generation communications systems are already under development and being discussed in international standardization bodies. Just as the technologies have evolved quickly, telecommunications industries have also shown a tremendous growth in handset development and mobile application services.

Although many new mobile communications technologies have been developed, not every innovation has been met with the expected acceptance by the mass market. The telecommunications market is very competitive, so some innovations are unsuccessful. WAP is one such example. In spite of the great buildup for WAP services and phones, service providers were unable to create a critical mass of users and solve the startup problem (Hibberd, 2000) due to compatibility problems and the lack of a ‘‘killer application.’

Globalization and liberalization have also increased the level of competition among manufacturers and operators in the telecommunications sector. This has brought about a price war not only in the handset market but also in the voice market, with the result that the average revenue per user (APRU) is in steady decline.

Therefore, when telecommunications companies decide to adopt an innovative mobile communications technology, they have to face not only the possibility of being overtaken by other emerging communication, broadband, or wireless technologies, but also the possibility of losing their huge investments in network infrastructure, operation licenses, or service development. For all of the operators, manufacturers, and service providers in the telecommunications sector, mass adoption plays a key role in determining whether the business gets a return on its investment.

Previous studies of the human adoption of ICTs have been based on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980), the technology acceptance model (TAM) (Davis, 1989), the theory of planned behavior (Ajzen, 1991), or the innovation diffusion theory (Agarwal & Prasad, 1997). These studies have focused primarily on the acceptance of ICTs in the workplace. Few have investigated consumers’ adoption of innovative ICT products. Furthermore, most of these studies were conducted at the launching or early market stage of innovation diffusion; it is unknown whether the findings of these studies could apply to the crucial stage between early market and mass market.

The purpose of this paper is to investigate the mass adoption of new generation mobile communications systems. As the relative popularity of a mobile communications system in the marketplace can usually be determined by the adoption of its carrier device, therefore, the adoption of 3G mobile phones in Taiwan is chosen because their adoption figures showed that they were at the crucial diffusion stage between early market and mass market at the time of the survey. The goals of the study are to identify the factors that influence most consumers to intend to adopt a new generation mobile phone.

BACKGROUND

Taiwan is experiencing a large-scale deployment of 3G mobile networks. By the end of 2006, the number of mobile phone subscribers in Taiwan had risen to 23.24 million, representing a penetration rate of 101.6% (MOEA, 2007), and the 3G service market had grown 157.5%; its 2.1 million subscribers represent about 10% of the total number of mobile phone subscribers (National Communications Commission, 2007). Although 3G mobile networks have been diffused in Taiwan, the integration of different kinds of wireless mobile networks, such as WLANs and WiMAX, have also been emerging. The WLANs system has achieved widespread adoption in Taiwan through its deployment in many hot spots in the public domain, office buildings, and homes, and most newly shipped laptops provide WiFi access. The alternative radio access systems of WiMAX, based on industry standards, are also becoming available.

Although 3G offers telecommunications operators the advantages of an efficient infrastructure that increases the data transfer rate and therefore the variety of services that can be provided on a mobile device, the penetration rate of 3G in Taiwan was lower than it was in other countries when the research was conducted. One possible reason was that the evolution from 2G to 3G had brought only a few novel and additional services, which left the business model largely unchanged and might not be sufficient to encourage customers to change their equipment (Shan, 2007).

To stay competitive and increase revenues, telecommunications operators had turned to value-added services (VAS), such as multimedia messaging services, voice/video mailboxes, and gaming. Recently, new forms of mobile services have been made possible, such as surfing the Web, watching TV news, making payments, banking, trading financial instruments, shopping, and other location-based services.

In order to increase the market demand, manufacturers of 3G mobile phones have also been developing new products in order to convince consumers to replace their handsets. There has been an explosive growth of handset items for mobile phones. The current mobile phone handsets not only support voice calls, but they also include many new features aimed at satisfying hedonic motivations, such as music players, digital cameras, and video recorders. Some handsets are even embedded with personal digital assistants to offer new personal information management functions that can satisfy consumers' utilitarian needs.

Because telecommunications businesses get a return on their investment only when the technology has received mass market acceptance, the ability to understand consumers'

technology adoption behavior has become a key issue for all stakeholders in the telecommunications industry. According to the diffusion-of-innovations theory developed by Rogers (1983), adopters of any new innovation can be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). Moore and McKenna (1999) point out that the chasm between the early adopters of the product and those in the early majority means that the most challenging step in marketing is to win over the so-called early majority in order to reach the mass market. The concern of this study, then, is in the mass adoption of an innovative technology, especially at the crucial stage between early market and mass market.

Research model and hypotheses

Adoption intention and purchase intention

For an analysis of consumer products, the consumer behavior of adoption process is suggested to consist of the purchase action because most consumers have to purchase the innovative product before being allowed to adopt it. When consumers form perceptions of the positive benefits of the innovation, they will intend to adopt it and proceed to form the purchase intention in order to fulfill their adoption intention. In addition, although the adoption intention is a concept widely used in TRA or TAM studies to predict users' actual use in the workplace, the concept of a purchase intention is more likely to be used by marketing researchers and practitioners as a proxy measure to predict the consumer's purchase action in the market.

Thus, an examination of purchase intention is important to consumer's adoption of technology. The consumer's adoption behavior of technology is assumed that includes two different but sequential cognitions: adoption intention and purchase intention. The construct of the adoption intention is defined as the likelihood that a person intends to use an innovative product; the construct of a purchase intention is defined as the likelihood that a person intends to buy an innovative product. The hypotheses are as follows:

H1. The constructs of adoption intention and purchase intention are different.
H2. The consumer's intention to use a new generation mobile phone will have a positive effect on her/his intention to buy one.

Perceived utility of the new technology

Understanding the antecedents for intentions to adopt new ICTs has been an issue for research since the mid-1970s. Davis (1989) developed the Technology Acceptance Model

(TAM) and proposed two cognitions, Perceived Usefulness (PU) and Perceived Ease-of-Use (PEU), as the crucial factors influencing the user's intention to adopt an innovative ICT. Besides PU and PEU, Davis et al. (1992) also concluded that enjoyment was one of the primary constructs influencing adoption intention.

The richness and elegant simplicity of TAM and its explanatory power have been demonstrated in many studies, so its theoretical framework has adapted to this study. It is assumed that consumers who perceive the utility of mobile communications technology will intend to use and buy the new generation mobile phone. It is also considered that the perceived usefulness, ease of use, and enjoyment are reflectors of the perceived utility of this kind of technology; therefore, the study's questionnaire items were generated on the basis of these reflectors in order to test the construct. The construct of perceived utility of the technology refers to the degree to which a person believes that he/she would benefit from the adoption of a new particular technology and the hypotheses are as follows:

H3. The consumer's perceived utility of the new technology will have a positive influence on his/her intention to adopt a new generation mobile phone.

H4. The consumer's perceived utility of the new technology will have a positive influence on his/her intention to buy a new generation mobile phone.

Perceived utility of the new services

Although most TAM studies have discussed technology adoption to predict users' actual use, Moore and McKenna (1999) have reminded us of the importance of the extrinsic value of technology to consumers. According to Moore's extension of the Roger's diffusion model, the differences between needs and behaviors of each adopter may stall the transition between stages. Moore observes that although pioneer adopters will tend to respond to the intrinsic value of a new technology, most consumers will seek the extrinsic benefits embedded in the service (Chakravorti, 2003). While discussing mass adoption of new technology, therefore, it is also necessary to pay attention to such extrinsic benefits as service adoption.

TAM has been applied not only to explain technology adoption, but also to describe the adoption of new services. Examples include studies of the motivations for adopting mobile gaming (Ha, Yoon & Choi, 2007) and mobile multimedia services (Hsu et al., 2007). Thus, the questionnaire items were generated about perceived usefulness, perceived ease of use, and perceived enjoyment to test the perceived utility of service. The hypotheses are as follows:

H5. The consumer's perceived utility of the new services will have a positive influence on his/her intention to adopt a new generation mobile phone.

H6. The consumer's perceived utility of the new services will have a positive influence

on his/her intention to buy a new generation mobile phone.

Perceived utility of the new handsets

It is observed that mobile phone manufacturers work hard to increase the functionality and usability of new generation handsets in order to convince consumers to replace their old phones. It is also noticed that some consumers buy new generation phones for their fascinating and novel built-in features but do not subscribe to the services. According to a study by Taylor Nelson Sofres (TNS) which is a market research company, 16% of mobile phone users in the United States owned 3G-enabled handsets by 2006, but only 10% actually made use of the enhanced services. The numbers were not much better globally; 20% had 3G, but only 9% used its services (Wireless News, 2006). Therefore, in discussing the mass adoption of new generation mobile phones, researchers should not only be concerned with technologies and application services, but also with handset product development.

Since TAM was demonstrated the validity to explain the consumer adoption of ICT devices (Bruner & Kumar, 2005), the questionnaire items were generated on the perceived usefulness, ease of use, and enjoyment of adopting one to ascertain the perceived utility of a new handset. The hypotheses are as follows:

H7. The consumer's perceived utility of the new handsets will have a positive influence on his/her intention to adopt a new generation mobile phone.

H8. The consumer's perceived utility of the new handsets will have a positive influence on his/her intention to buy a new generation mobile phone.

Based on the literature review and hypotheses, the conceptual framework as depicted in Figure 1 has been developed. The three factors — perceived utility of the new technology, perceived utility of the new services and perceived utility of the new handsets — are hypothesized to influence the dependent variables of adoption intention and purchase intention.

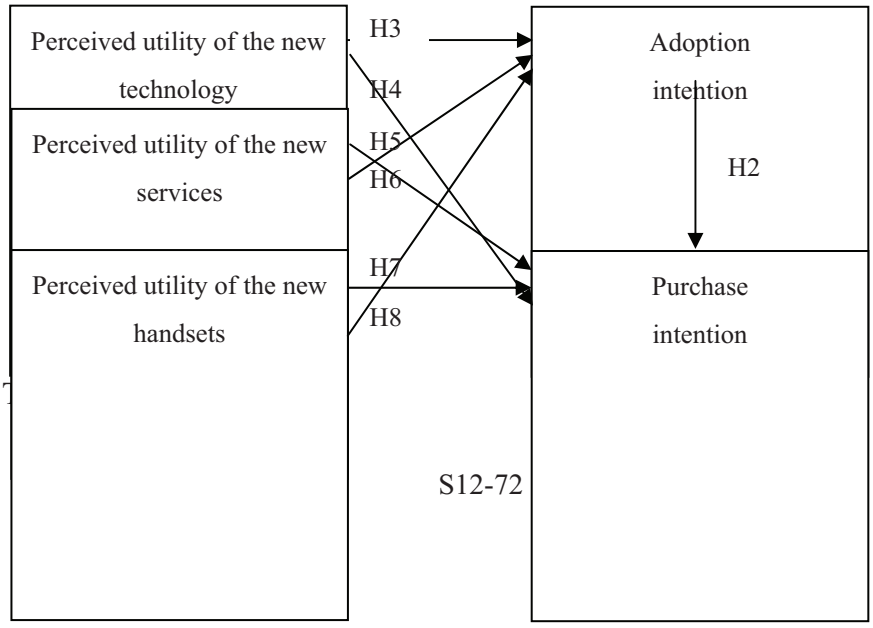

Figure 1. T

Research methodology

Instrument development

An empirical study was administrated to test the model. To generate the questionnaire, the multiple-item scales drawn from pre-validated measures in IS/IT TAM studies were used to ensure the validity of their content; they were also reworded to fit the context of 3G mobile phone use (see Appendix A). All questionnaire items were based on a 5-point Likert scale anchored between "strongly agree" and "strongly disagree." All of the measures were initially tested in a small-scale pilot study, and results from the pilot study led to several changes in the wording of the final version of the questionnaire.

Table 1. Descriptive statistics of the respondent's characteristics

Measure	Items	Frequency	Percent	Remark
Gender	Male	137	48.8	
	Female	144	51.2	
Age	Under 25	9	3.2	
	25-29	105	37.4	
	30-34	81	28.8	
	35-39	41	14.6	
	40 & up	45	16.0	
Income	Under 20,000	57	20.3	
	20,001-35,000	103	36.7	
	35,001-50,000	82	29.2	
	50,001-65,000	20	7.1	
	65,001-Up	19	6.8	
Occupational	Executives	5	1.8	
category	Manager	34	12.1	
	Professional	60	21.4	
	Administrative staff or sales	62	22.1	
	Self-employed	5	1.8	
	Freelance	14	5.0	
	Unemployed	26	9.3	The Taiwan's minimum monthly wage is currently NT$17,280(US$533) in 2007.
	Housewife	10	3.6	
	Student	33	11.7	
	Others	32	11.4	
Total		281	100	

Sample collection and procedures

According to statistics released by Taiwan's National Communications Commission, the penetration rate of mobile phone service subscribers reached 101.6% in 2006, which means that on average almost every person in Taiwan owns a mobile phone. The survey was conducted in July to August of 2007. 500 questionnaires were distributed to the participants of open enrolment courses or evening classes in a private university in Taipei. Most of the participants worked during the daytime and studied at night or on the weekends. The participants self-administered the questionnaire. For each question, respondents were asked to circle the response that best described their level of agreement with the statement.

The 335 complete questionnaires were collected, yielding a respondent rate of 67%. The responses of the 54 (16%) who already had 3G phones were eliminated because the hypothesized model concerned consumers' adoption behavior in relation to a 3G phone, valid respondents could not include those who had already adopted and bought 3G phones. After this elimination, there were 281 valid respondents in the study. Of these respondents, 51% were female and 49% male, and the majority (80%) had monthly incomes greater than the 2007 minimum monthly wages in Taiwan. The profiles of the valid respondents are shown in Table 1.

Since 3G subscribers represented over 10% of the total market when the survey was conducted; moreover, approximately 16% of respondents in the study already owned a 3G phone, these figures indicated that 3G diffusion was at a crucial stage between early market and mass market.

Scale validity and reliability

To verify the scale for measuring the constructs, the factor analysis (Kerlinger, 1986) was used with principal component analysis by oblimin rotation to assess distinctions among those perceived utility constructs and to ensure the construct's validity. Table 2 shows the results of the factor analysis; three factors with an eigenvalue greater than unity were extracted. They were identified as the perceived utility of the technology, the perceived utility of the services, and the perceived utility of the handset. The results showed that the three constructs of perceived utility demonstrated evidence of discriminant validity. The three observed factors accounted for 65.57% of the total variance.

Table 2. Principal component analysis with oblimin rotations.

Scale items	Factor (Technology)	Factor (Handset)	Factor (Service)
Item 1	**.786**	-1.634E-02	-3.418E-02
Item 2	**.864**	7.491E-03	-5.007E
Item 3	**.761**	4.159E-02	.122
Item 4	**.739**	.110	8.446E-02
Item 5	..298	6.520E-02	**.522**
Item 6	-2.182E-02	.115	**.737**
Item 7	-9.077E-02	2.600E-02	**.832**
Item 8	.206	-.106	**.702**
Item 9	.105	**.741**	2.656E-02
Item 10	-8.540E-03	**.929**	-.133
Item 11	8.442E-02	**.840**	2.378E-02
Item 12	-8.904E-02	**.596**	.308
Eigenvalues	5.311	1.520	1.037
% of variance	44.262	12.666	8.638
Cumulative %	44.262	56.928	65.566

Internal consistency was evaluated using Cronbach's alpha test. Table 3 lists the means and internal consistency of each of the constructs. In general, a measurement with internal consistency exceeding 0.70 is considered reliable (Nunnally & Bernstein, 1994). As shown in Table 3, the internal consistency values of all the constructs in our model exceed this recommended threshold.

Table 3. Construct Means and Internal Reliability

Construct	Number of items	Mean	Cronbach Alpha
Perceived utility of technology	4	3.66	.83
Perceived utility of service	4	3.15	.83
Perceived utility of handset	4	3.46	.77
Adoption intention	2	3.06	.88
Purchase intention	2	2.35	.93

Data analysis and results

Analysis of the measurement model

To ensure the suitability of the empirical data for predetermined statistical analysis procedures, the adequacy of the measurement model was examined with a confirmatory factor analysis using LISREL 8.5 (Jöreskog & Sörbom, 2000). To assess a measurement model's overall goodness of fit, researchers follow a common practice of reporting a goodness-of-fit index (GFI) (Bentler & Bonett, 1980), an adjusted goodness-of-fit index (AGFI) (Bentler, 1980), a comparative-fit index (CFI) (Bentler, 1988), a normed-fit index (NFI) (Bentler & Bonett, 1980), a standardized root mean square residual (SRMR) (Bentler & Yuan, 1999), and a root mean square error of approximation (RMSEA) (Browne & Cudeck, 1993). A good fit to the model is suggested by GFI, CFI, and NFI values higher than 0.90; an AGFI value higher than 0.8; a RMSEA value below 0.05; and an SRMR value lower than 0.08. Hair et al. (1998) suggested that RMSEA value lower than 0.08 is an acceptable value for fair fit. The result shows good fit values with GFI at 0.90, AGFI at 0.86, NFI at 0.90, NNFI at 0.92, CFI at 0.94, SRMR at 0.049, and RMSEA at 0.075. The overall result of the CFA suggests that the measurement model provides a satisfactory fit to the data. A similar set of fit indices is used to respectively examine the structural models (see Table 4). The overall result suggests that the structural models also provide evidences of satisfactory model fits.

Table 4. Fit indices for measurement and structural models

Goodness-of-fit measure	Recommended value	Hypothesized model		
		Measurement	Structural	Fit evaluation
GFI	>0.90	0.90	0.90	good
AGFI	>0.80	0.86	0.86	good
NFI	>0.90	0.90	0.90	good
NNFI	>0.90	0.92	0.92	good
CFI	>0.90	0.94	0.94	good
SRMR	<0.08	0.049	0.049	good
RMSEA	<0.08	0.075	0.075	good

Hypotheses testing

A factor analysis was used to test the discriminant validity in order to specifically explore the difference between adoption and purchase intentions. The result also showed that two factors were extracted (see Table 5). Thus, the hypothesis that adoption and purchase intentions are

different (H1) is supported.

Table 5. Principal component analysis with oblimin rotations.

Scale items	Factor 1 (Adoption intention)	Factor 2 (Purchase intention)
Item 13	**.944**	.067
Item 14	**.962**	-.063
Item 15	-.011	**.981**
Item 16	.012	**.978**

The proposed hypotheses were examined by performing a path analysis. As expected, the adoption intention was found to have a significant positive effect on the purchase intention; the perceived utilities of the new mobile technology and new mobile services were found to have significant positive effects on the adoption intention. The perceived utility of a new mobile handset was also found to have a significant positive effect on purchase intention, but the significance of this effect was marginal. Unexpectedly, the perceived utility of technology was found to have a significant negative effect on the purchase intention. Thus, H2, H3, H5 and H8 were supported; H4, H6, H7 were not supported (see table 6).

Table 6. The path coefficients and t-values of the model

Exogenous constructs / Endogenous constructs		Adoption intention	Perceived utility of technology	Perceived utility of service	Perceived utility of handset
Adoption intention	Path coefficient		0.58	0.66	-0.10
	t-value		3.16	5.09	-0.55
	Hypothesis		H3 (supported)	H5 (supported)	H7 (unsupported)
Purchase intention	Path coefficient	0.59	-0.41	-0.08	0.33
	t-value	7.40	-2.28	-0.61	1.97
	Hypothesis	H2 (supported)	H4 (unsupported)	H6 (unsupported)	H8 (supported)

DISCUSSION

Analyzing the results of above data analyses, it is found that the adoption of a new generation mobile phone is a composite concept that consists of three constructs: new technology adoption, new service adoption, and new handset adoption. The perceived utility of technology and service were found to have significant effects on the adoption intention in the study, but the influence of perceived utility of service was more significant. This result suggests that the adoption level of new mobile services will determine the market success of

new generation mobile phones. The results justify Moore and McKenna's (1999) observation that the majority of consumers tend to seek extrinsic benefits through a product's use, and these benefits may rely on network externalities embedded in the service.

In addition, the perceived utility of a new handset was found to have a marginally significant effect on the purchase intention, which suggests that enhancing the 3G phone handset with built-in features and a new design could directly encourage some consumers to buy the product. This result might explain the phenomenon of some consumers purchasing 3G phones without subscribing to the 3G services. However, the effect is only marginally significant, which means that not all consumers would be attracted by the novel functionality and design features of a new handset. The enhancement of new handsets would only attract some consumers to the idea of replacing their handsets.

Moreover, we find a striking and interesting result that perceived utility of technology has a negative effect on purchase intention, although the significance is marginal. It suggests that many respondents at the mass market perceive benefits of 3G technology and intend to adopt it, but they are not ready to buy the 3G mobile phone.

It was also demonstrated that the consumer's adoption behavior of technology includes two different and sequential cognitions – adoption intention and purchase intention. The results show that the distinction between these two intentions does indeed exist. This insight is different from most studies of technology adoption, which usually hypothesize only one adoption intention to predict the user's actual use. This finding reminds researchers that they have to consider not only the technology acceptance behavior but also the purchase behavior when they discuss the consumer's adoption of a mobile phone with new technology

Limitations and Implications

Before discussing the implications of the findings, certain limitations inherent in this empirical study were acknowledged. The first limitation is that the respondents all came from one local university, so the survey may have introduced a sampling bias. Moreover, the measurements of perception came through self-report. Although the method of self-reporting is often used in TAM research, external validations of the measurements would have been preferable. The third limitation is that demographic variables--such as sex, age, or income level-- may present moderating variables in the adoption intention and the purchase intention in the model. In addition, some studies have demonstrated that the adoption behavior between adults and students is different. Thus, further research or cross-validation studies should be conducted. Another limitation is that the findings may be vulnerable to the shortcomings of

conducting a survey in a specific country so that the results might be relevant only to the local cultural context.

Despite these limitations, our study provides insights into the mass adoption behavior of wireless communication technologies and mobile phones. It is demonstrated that the consumer's adoption behavior includes the purchase intention, a concept that has been widely used by marketing researchers as a proxy measure to predict consumer's purchase action but which has seldom been discussed in TAM studies.

For mobile phone handset manufacturers, the study suggests that collaboration with telecommunications operators to offer new services might be an effective way to motivate users to replace their handsets. In addition, the enhancement of built-in functionality and hedonic design in a new generation mobile phone could encourage some consumers to adopt one, although the effect is only marginally significant. For telecommunications businesses, therefore, we suggest that the operators should invest more effort and resources into offering useful services to attract new customers at the chasm stage.

In today's competitive telecommunications market, the transition of wireless communication systems from the current generation to the next generation involves more than simply upgrading the technology; the consumers' adoption behavior is as important as the nature of the technological innovation. A technical development is not enough to explain the evolution of technology; consequently, it is necessary to understand the consumer's adoption behavior and to identify the market drivers, particularly in the mass market. This study reveals some fundamental consumer adoption behaviors that can help those in the field of telecommunications --from manufacturers to operators--effectively implement appropriate strategies to diffuse new generation mobile phones or mobile communications systems.

APPENDIX A. CONSTRUCT ITEMS

	Construct	Item
1	Perceived utility of the new technology	1. I believe that 3G technology will improve the communication quality of a mobile phone.
		2. I believe that 3G technology will make the work of date transfer easier.
		3. I believe that 3G technology could satisfy my need for multimedia effects.
		4. I believe that 3G technology could satisfy my need for video effects.
2	Perceived utility of the new services	5. I believe that the 3G services offered by operators will satisfy consumers' needs.
		6. I believe that the 3G services offered by operators are easy to obtain.

		7. I believe that the 3G services offered by operators are easy to use.
		8. I believe that the content of 3G services offered by operators is interesting.
3	Perceived utility of the new handsets	9. I believe that a 3G handset has many functions.
		10. I believe that a 3G handset is easy to use.
		11. I believe that a 3G handset is easy to carry.
		12. I believe that a 3G handset offers many entertainment functions.
4	Adoption intention	13. I intend to use a 3G mobile phone.
		14. I predict that I will use a 3G mobile phone.
5	Purchase intention	15. I intend to buy a 3G mobile phone.
		16. I plan to buy a 3G mobile phone.

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E-BUSINESS AND SLOVENIAN SMEs

Dr. Viktorija Sulčič, University of Primorska Faculty of Management, Slovenia, viktorija.sulcic@fm-kp.si
Dr. Dušan Lesjak, University of Primorska, Faculty of Management, Slovenia, dusan.lesjak@fm-kp.si

ABSTRACT

Small and the medium-sized enterprises (SMEs) are socially and economically very important since they represent 99% of all enterprises in the EU and more than 96% of all enterprises in Slovenia. In the paper, firstly the comparison of e-business in Slovenian and some other regions is presented and secondly e-business impacts and obstacles among Slovenian SMEs are discussed. Not only infrastructure is needed to extend e-business among SMEs, which is the case among Slovenian SMEs. Even if the broadband access to the Internet in Slovenia is not a problem anymore, B2B e-business is not common among Slovenian SMEs as it is in the EU countries. On the other hand, B2G and C2G services are more common among Slovenian companies and even among individuals than in the EU countries. Implementing e-business was done mostly due to management demand and impacts communication inside and outside the enterprise. The e-business implementing or maintaining cost and lack of staff could be a serious obstacle for e-business implementation and usage.

Keywords: e-business, SMEs, Slovenia

INTRODUCTION

E-business is a broader definition of e-commerce, which is defined as the process of buying, selling, or exchanging products, services or information via computer networks (15). According to Turban (ibidem) e-business covers servicing customers, collaborating with business partners, and conducting electronic transactions within an organization. Based on the stakeholders in e-business process – businesses, costumers, government, different models of e-business occur – e.g. business-to business (B2B), business-to-consumer (B2C), business-to-government (B2G), consumer-to-government (C2G) (2). Turban (15) introduced intrabusiness e-commerce, which covers all internal organizational activities of exchanging goods, services or information among stakeholders in the company. Business-to-employee is one of the models of intrabusiness (ibidem). Nowadays more than e-business, m-business (B2E) is the core term describing business activities conducted through wireless connections. When such activities are targeted to individuals in specific locations, at specific times, location-based business (l-business) is an appropriate terms to use.

Nowadays e-business is not primary about ICT, but about accessing, providing and sharing information in business networks e.g. it is about doing business in the advanced digital economy (5). Although today firms continue to use ICT cost cutting, ICT is increasingly recognised as an important tool for innovation and increasing revenues. New services and new ways of working within value networks have appeared. Firms compete in new ways and they are forced to cooperate. The

knowledge-intensive activities became more and more important. Companies are increasingly focusing on their core competencies and they outsource non-core business processes. EC forecasts a number of changes in using ICT for doing business: (5)

- ICT infrastructure becomes mature, particular among SMEs;
- E-business goes far beyond concluding transaction – ICT is used to do better services for firms customers and to create sustained relationships with them;
- ICT improves the transparency of internal processes which facilitates planning and decision-making;
- Outsourcing non-core business processes;
- ICT usage for sustainable industrial development, where ICT is used to reduce energy usage;
- ICT enables the introduction of innovation in business processes.

ICT offers opportunities and challenges to small firms (5). On the one hand, small firms have the opportunity to expand their markets, to cooperate with others and to support their processes by ICT because appropriate solutions for SMEs have been developed, and on the other hand, SMEs often lack ICT investment strategies or related skills and the ability to comply with different systems in parallel especially when SMEs are trading with larger firms (ibidem).

According to the European Commission small and medium-sized enterprises (SMEs) are enterprises with less than 250 employees (those with fewer than 10 employees are micro enterprises and with more than 10 and less than 50 employees are small) (3). SMEs are socially and economically important, since they represent 99% of all enterprises in the EU and provide around 65 million jobs and contribute to entrepreneurship and innovation to a great extend (3).

Slovenia – situated between Italy, Austria, Hungary, and Croatia – is the leading country among 10 new member states that joined EU in 2004 and a country with ICT characteristics, which are usually slightly above the EU-25 average, surpassing some 3–5 of the EU15 old member states in the aspect of ICT developments. In recent years, various studies explicitly confirmed this, e.g. Stare et al. (10), IDC (8), and Eurostat (7). In addition, Vehovar and Jovan (16) compared Slovenian companies with SIBIS (Statistical Indicators Benchmarking the Information Society, a project in the Information Society Programme founded by the EC) research among EU-15 countries and they found that Slovenia was above the EU-15 average in basic ICT (computers, internet access, web pages); however it lagged behind the EU-15 average in some advanced technologies (video-conferencing, intranet, etc.) (10). Similar findings arose from the Eurostat (6) study on ICT among companies.

In the paper, a comparison between SMEs in Slovenia and the EU is presented with the aim to find out the similarities and differences or gaps and the potential reasons for that. The secondary data available from the National Statistical Office and Eurostat (Statistical Office of the European Communities) were used. Recent reports about information society indicators were made in 2003 (10) so we conclude our paper with the overview of e-business characteristics of the Slovenian SMEs by data from the research made at the beginning of October 2008 regarding e-business impacts and obstacles among 49 Slovenian SMEs.

SLOVENIA AND SMEs

Slovenia compared to other EU countries and other regions

Since SMEs make up the backbone of European economy (4) we carried out profound research about e-business activities among Slovenian SMEs. Large companies are mentioned just for the comparison. We compared Slovenian SMEs data with data for the EU countries – EU-15 (EU in 1995 with 15 countries), EU-25 (EU in 2005 with 25 countries) and EU-27 (EU in 2007 with 27 countries, including Bulgaria and Romania) data. EU-15 countries are more economically developed than EU-25 or EU-27 countries (Table 1). Slovenia, the country with no more than 2 million citizens, with 16.600 € GDP per capita has a higher GDP per capita than Portugal (15,300 €), a EU-15 member, and a lower GDP than Cyprus (19,800 €) that join the EU in the same year as Slovenia (in 2004).

Table 1. GDP at market prices and IT/communication expenditure

Region / State	GDP per capita (in 2007)	% of GDP expenditure for … (in 2006)	
		IT	Communication
EU-15	29,100 €	2.7	2.9
EU-25	26,000 €	NA	NA
EU-27	24,700 €	2.7	3.0
Slovenia	16,600 €	2.2	3.6
USA	33,400 €	3.3	2.1

Source: Eurostat (6). Legend: NA – data not available.

The negative gap between Slovenia and EU-27 countries is smaller when a comparison is made with GDP per capita in Purchasing Power Standards that placed Slovenia with 88.0 index behind the EU-27 countries (100.0) in 2006, but a forecast for 2008 reduced this gap by more than 3 percentage points to 91.1. Slovenia spends lower % of GDP for IT compared to the EU average, which in a way reflects the smallness of its economy, yet on the other hand spends a larger % of GDP for communications, which results in the availability of various modern communication services.
In

Table 2, the comparison between Slovenia, USA, Japan and between the East Asia and Pacific group of countries and the high-income group countries (such as Europe, USA, Canada, Australia, Emirates, etc.) is presented. Slovenian GDP increased faster than in the USA and Japan, which is logical due to the transition process Slovenia has been going through. It is known as well as from the investments in telecommunications that Slovenians use mobile phones more frequently (90.7%) than citizens in more developed country.

Table 2. ICT usage around the world

Variables	Slovenia	USA	Japan	East Asia & Pacific	High-income group
Population (in millions)	2	299	128	1,899	1,031
GDP growth (1995–2000&2000–2006 in %)	3.7	2.6	1.5	8.6	2.3
Mobile phone subscribers (in %)	90.7	77.8	79.6	34.7	90.1
Internet Users (in %)	62.3	69.5	68.5	11.1	59.3
Personal computers (in %)	40.4	76.2	67.6	4.1	56.7
Broadband subscribers (in %)	13.4	19.42	20.16	3.56	19.20
ICT expenditure (% of GDP)	3.1	8.7	7.9	5.3	7.2
E-government readiness index (from 0 to 1)	0.67	0.86	0.77	0.43	0.74

Source: WorldBank (17)

According to the World Bank methodology (17) Slovenian citizens demonstrate greater readiness for e-government than countries from East Asia and Pacific region (0.67 vs 0.43) but less than it was ascertained in the USA, Japan and in high-income group countries.

Enterprise structure in Slovenia

In Slovenia 96.2% of enterprises are micro or small enterprises in which 45.0% of all employees are employed (Table 2). In less than 1 % of Slovenian large companies one third of employees are employed. In the EU, 99% of all enterprises are SMEs in which 67.1% of employees are employed (4). The main reasons why the percentage of employees in SMEs in Slovenia is more than 20% lower than the EU average, is firstly the final stage of the transition process from former socio-economical system where there were predominately large state owned companies and secondly, the smallness of the economy, which is together reflected in the relative big percent of employees in the micro firms.

The portion of enterprises included in the research is presented in **Table 3**, together with the number of all enterprises and the employment situation.

Table 3. Slovenian enterprises in 2006

Enterprise category	Employees	# of enterprises	%	# of employees	%	Enterprises in the research
Micro	< 10	33.371	82.4	171.535	27.6	20.5%
Small	< 50	5.601	13.8	108.554	17.4	87.7%
Medium-sized	< 250	1.255	3.1	131.223	21.1	92.0%
Large	250+	284	0.7	211.057	33.9	84.5%

	40.511	100.0	622.369	100.0

Source: SURS (13), (14)

The portion of micro enterprises included in the research is small because they are not ready to participate in this kind of research and the drop-out among this enterprise category is higher than among bigger enterprises.

Computers and networks usage

More than 90% enterprises included in the survey use computers (micro: 93.6%, small: 97.2%, medium-sized: 99.2%). In medium-sized enterprises all computers are connected to the Internet, in micro enterprises 91.2% and in small enterprises 95.5% are Internet connected (14). According to Eurostat (6) more Slovenian SMEs have access to the Internet (96%) than SMEs in the EU-27 (93%) and even in the EU-15 (95%). Most of companies access the Internet through a broadband connection (micro: 68.5%, small: 75.4%, medium-sized: 92.0%). The comparison between EU countries and Slovenia is presented in Table 4.

Table 4. Internet broadband access (in 2007)

Enterprise category	EU-27 (%)	EU-25 (%)	EU-15 (%)	Slovenia (%)
Small	75	77	79	75
Medium-sized	88	90	92	92
Large	95	97	97	99
Households	46	43	42	44

Source: Eurostat (6)

Slovenian medium-sized and large enterprises are in the same or even in a better position regarding the broadband Internet access than similar companies in most developed countries in the EU (EU 15) (Table 4), which means that Slovenian telecommunication infrastructure offers similar conditions as the EU.

Internet broadband access enlargement among enterprises and households (**Table 4**) offers employees opportunities to remote connection to their IT systems. Larger companies offer more possibilities that the smaller ones (**Table 5**).

Table 5. Remote connections to the enterprise's information systems from home (2006)

Enterprise category	EU-27 (%)	EU-25 (%)	EU-15 (%)	Slovenia (%)
Small	13	14	15	23
Medium-sized	30	32	35	32
Large	55	57	63	65

Source: Eurostat (6)

It is interesting that in Slovenia there are more employed persons who connect from their home to enterprise's information system than in other EU countries, what is probably related to the accessibility of the broadband connection presented in **Table 4** and the popularity of e-work among Slovenian employees.

A number of researched Slovenian enterprises used intranet and extranet networks as well (**Table 6**).

Table 6. Intranet and extranet networks and Slovene SMEs

Enterprise category	Intranets (in %)	Extranets (in %)
Micro	12.5	13.4
Small	21.4	16.2
Medium-sized	48.1	16.1

Source: SURS (14)

Extranet networks are almost equally spread among SMEs, as the differences among intranets usage (**Table 6**). Intranet networks are used more frequently in medium-sized enterprises than in micro or small one.

IT experts and SMEs

Various resources are normally rarer in SMEs than in large enterprises while outsourcing, especially for IT support, is a common strategy in SMEs and in large companies (9). Slovenian SMEs implement the same strategy, micro and small enterprises more often than medium-sized and large enterprises (Table 6).

Table 7. IT in- and outsourcing (in 2006)

Enterprise category	Hiring IT services by companies in Slovenia (%)	Hiring IT services by companies from abroad (%)	Employed IT experts (%)
Micro	42.2	3.2	6.9
Small	58.6	5.1	13.8
Medium-sized	82.2	14.7	41.0

Source: SURS (14)

IT experts have not many possibilities to be employed in SMEs, because enterprises, which they are not in the ICT business, do not employ them intensively (Table 6). More possibilities exist among large enterprises (85.4%). It is interesting that a a lot of IT services is hired from other companies within Slovenia. We expected that a larger portion of micro and small enterprises would hire IT services than the medium-sized ones, but this was not the case. In 82.2%, medium-sized enterprises used outsourced IT services even if they had employed IT experts (41.0%).

E-BUSINESS AMONG SMEs

B2B and B2C e-business activities

E-business or e-commerce was born before the World Wide Web (WWW) appeared in 1990. The first e-business applications are connected to the electronic funds transfer in 1970s and followed by electronic data interchange (EDI) (15). EDI, a technology used to transfer routine documents, was conducted through relatively closed and expensive networks that connected together large enterprises that could afford this kind of connectivity. EDI is not widely spread among Slovenian SMEs,

since only 2.2% of micro, 1.3% of small and 3.9% of medium-sized enterprises is use it. Even among large enterprises EDI is not intensively used – only 15.0% use it for making orders. Micro and small companies exchange their data by using EDI mostly through the Internet. Closed networks are safer but also more expensive and therefore not so accessible to smaller companies.
In **Table 8**, data about enterprises that had purchased online during the last year at least 1% of their purchases are presented. Purchasing e.g. e-buying can be performed through the Internet or/and other electronic networks.

Table 8. Enterprise online purchasing (in 2007)

Enterprise category	EU-27 (%)	EU-25 (%)	EU-15 (%)	Slovenia (%)
Small	28	29	33	20
Medium-sized	34	36	41	22
Large	44	46	53	29

Source: Eurostat (6)

Despite the Internet broadband connection expandability (Table 4) there is a similarly a large gap between e-buying activities among Slovenian enterprises and enterprises in other EU countries. The gap is larger in medium-sized and large enterprises than among small companies (**Table 8** and **Table 9**).

Table 9. Enterprise online selling (in 2007)

Enterprise category	EU-27 (%)	EU-25 (%)	EU-15 (%)	Slovenia (%)
Small	14	15	16	8
Medium-sized	20	22	24	14
Large	31	33	37	31

Source: Eurostat (6)

Enterprises are using web pages, which can be used solely as a presentation or as an e-business platform (**Table 10**).

Table 10. Slovenian SMEs web pages (in %)

Enterprise category	Presence	Products/services	Price lists	Post-selling activities
Micro	40.1	35.9	17.9	11.7
Small	61.1	53.5	26.9	18.1
Medium-sized	84.0	75.4	46.2	22.4

Source: SURS (14)

Medium-sized enterprises are more active on the Internet (**Table 10**) than micro and small enterprises, but post-selling activities are presented only by one fifth of them. Almost all large enterprises are present on the Internet – 95.0% have their own web page, on which 91.7% of products and services are presented, but only 31.3% of them offer their post-selling activities through the Internet.

Internet may be used for various purposes – finance and banking, marketing research, etc. is more present than training and learning (**Table 11**).

Table 11. Internet activities among SMEs

Enterprise category	Banking and Finance	Market data gathering	Training and learning
Micro	81.7	55.7	35.3
Small	91.2	71.2	44.5
Medium-sized	96.5	80.1	51.9

Source: SURS (14)

Orders in SMEs (**Table 12**) are more often supported by IT than invoices. Slovenian SMEs send invoices electronically (3.0% of micro to 15.5% of medium-sized enterprises), and receive them electronically (4.9% of micro to 7.9% of medium-sized enterprises). It is interesting that large enterprises send more e-invoices (15.4%) than they received them (13.3%).

Medium-sized enterprises use IT more intensively than smaller companies. Production and logistics processes are not supported so intensively than other processes (**Table 12**). The ERP (Enterprise Resource Planning) systems are used in less than 10% of micro and in one fifth of small companies. In medium-sized enterprises, ERP systems are used in a half of them, and in 75.4% of large enterprises. CRM (Customs Relationship Management) systems are less presented in SMEs and the differences are less evident than ERP systems. CRM systems are not frequently used in large enterprises (37.5%).

Table 12. IT to support business processes

Enterprise category	Orders	Production/Logistic	ERP	CRM
Micro	27.8	7.9	8.1	12.0
Small	40.0	16.5	20.7	19.2
Medium-sized	62.9	36.2	48.1	34.0

Source: SURS (14)

Encryption and digital certificates are used in 39.1% of micro enterprises, in 46.3% of small and in 59.0% of medium-sized enterprises.

B2G e-business activities

The availability of online public services are measured by Capgemini and presented by annual reports (1). Austria is placed on the first place among European countries, succeeded by Malta, Estonia, Sweden, Norway and the UK (ibidem, 8). According to the Capgemini report (1) Slovenia has moved from rank 15 in 2005 to 7 in 2006. Regarding the portion of online availability of 20 basic public services, Slovenia is placed on the fourth place (close to 90%) after Austria (100%), Malta (96%) and Portugal (90%). (6)

Eurostat (6) keep track of governmental services offered via Internet (supply side) and which are demanded by enterprises and individuals from the EU countries (**Table 13**).

Table 13. E-government services among EU countries

E-government services	EU-27 (%)	EU-25 (%)	EU-15 (%)	Slovenia (%)
E-government (supply side)	59	NA	NA	90
B2G (demand side)	65	66	66	83
C2G (demand side)	30	32	34	30

Source: Eurostat (6)

There are more government services available in Slovenia than in the EU-27 countries. Thus, it is not surprising that there are more enterprises (>10 employees) in Slovenia (83%) that use Internet to interact with public authorities (B2G) than in the EU countries, where there is no differences in the EU-15, the EU-25 or the EU-27. In Table 14 are business-to-government (B2G) services among SMEs in Slovenia.

Table 14. B2G among SMEs

Enterprise category	General usage	Acquiring information	Acquiring forms	Returning fulfilled forms	Conduction all activities
Micro	59.3	53.3	48.9	36.3	29.1
Small	80.2	74.4	72.3	55.5	42.9
Medium-sized	93.6	91.5	89.5	79.6	68.1

Source: SURS (14)

As expected, the relations between businesses and the government are more supported by IT among medium-sized (93.6%) than among small and micro firms. Government web pages are mostly used to get information about various matters and to download various forms. It is interesting that the whole B2G process is supported electronically, and used more by medium-sized firms (68.1%) than by large firms (64.6%).

SMEs E-BUSINESS IMPACTS AND OBSTACLES

In October 2008 a telephone research was done among 49 Slovenian SMEs - 19 micro, 13 small and 17 medium-sized enterprises (12). The respondents expressed their agreement with the impacts that the implementation of e-business had in their environment on a 5-degree scale (5=totally agree, 1=not agree at all). According to the small enterprises implementing e-business increases their effectiveness (M=4.1) and the product/service sales. The increased effectiveness was exposed by small (M=4.2) and medium-sized (M=4.5) enterprises as well.

Table 15. E-business impacts

Implementing of e-business...	Micro	Small	Medium-sized
... decrease enterprises costs	3.6	3.2	4.2
... increase enterprise effectiveness	4.1	4.2	4.5
... increase enterprise reliability	3.8	4.0	4.2
... increase the products/services sales	4.1	3.8	4.3
... increase the profit	3.9	3.9	4.4
... increase communication with customers	3.6	4.1	4.6
... increase communication with suppliers	3.4	3.6	4.3
... increase communication inside enterprise	3.1	3.6	4.1
... retain the enterprise market position	3.8	3.6	3.9
... retain the connection to its competitors	3.4	3.4	3.8
... enable the competitive advantage	4.2	4.2	4.4
... enable to acquire new knowledge	4.4	4.3	4.4
... improve the relationship with customers	3.5	4.1	4.5
... make information access more rapid	4.7	4.2	4.7
... standardize business processes	3.9	3.6	4.5

... integrate business processes	3.7	3.4	4.4
... decrease paper consumption	3.9	3.2	3.7
... shorter delivery time	2.8	3.0	3.4
... increase the product/service quality	3.7	3.5	3.7
... because of the supplier demand/pressure	3.0	3.2	3.0
... because of the purchaser demand/pressure	4.0	3.5	4.2
... because of the employee demand/pressure	3.8	3.2	3.8
... because of the enterprise management	4.2	3.9	4.4

The implementation of e-business has an impact on communication inside and outside the enterprise – more among medium-sized enterprises, where the communication with customers increases the most (M=4.6). Micro companies did not perceive the increase in communication to such a large extent. As we can see in **Table 15** e-business was implemented in enterprises mostly because of management demand or pressure.

Table 16. Obstacles for e-business implementation (in %)

E-business implementation obstacles	Micro	Small	Medium-sized
No great benefits from e-business.	17.7	6.8	
E-business is not trustworthy.			
E-business threats the existing business.			
No adequate staff employed to implement e-business.	23.5	20.0	10.0
E-business implementation costs are too high.	17.6	33.3	20.0
E-business maintenance costs are too high.	17.6	13.3	10.0
E-business is difficult to integrate with existing businesses.	11.8		
Management is not interested in e-business implementation.	5.9	13.3	10.0
Employees are not interested in e-business implementation.			10.0
Suppliers and purchasers do not want e-business activities	5.9	13.3	30.0
Weak government support for e-business implementation.			
Poor national legalisation.			10.0

In addition to positive impact of the e-business implementation there are still many obstacles that prevent the extent of e-business implementation in surveyed enterprises (**Table 16**). According to the surveyed enterprises micro enterprises do not have adequate staff which could implement and support e-business (23.5%). E-business implementation or maintenance cost could be a serious obstacle 35.2% for micro enterprises. Small enterprises get anxious about e-business implementation costs (33.3%). One fifth of them do not employ adequate staff as well. One third of medium-sized enterprises are concerned because their suppliers and purchasers do not wish to do business through the Internet (30.0 %).

CONCLUSION

Slovenian efforts in telecommunication infrastructure (3.6% of GDP expenditure) resulted in a relatively high level of broadband Internet connection availability that is above the EU countries average (Table 4). The portion of the expenditure for IT purposes is below the EU countries, which results among others in a lower extent of e-business activities. It is obvious that the Internet, because of its accessibility, offers more possibilities than others pre-Internet networks for e-business activities to SMEs. Because poor telecommunication infrastructure is not an issue anymore in Slovenia

other factors could have an impact on the presence of SMEs e-business activities. The main reason for the lack of e-business activities among SMEs mostly lies in scarcity of IT resources. SMEs could not afford to employ their own IT experts, therefore the majority of IT activities are outsourced. In a small country such as Slovenia, finding adequate companies, which offer IT services, could be a real problem. Another problem, found in our research, is related to the software used for e-business activities.

Regarding e-business impacts and obstacles we found out that e-business implementation was done mostly due to management demand or pressure and impacts communication inside and outside the enterprise. E-business implementation or maintenance cost and lack of staff could be a serious obstacle for e-business implementation and usage.

Another characteristic of e-business is that that open source software is not frequently used among Slovenian enterprises – only 7.3% of surveyed micro enterprises, 11.5% of small and 15.5% of medium-sized enterprises used open source software. We believe that open source solutions usage may lower e-business software costs and consequently eliminate main e-business obstacles and therefore help SMEs to be more e-business active and to enlarge their markets.

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A Multinomial Logit Model on Taiwan's Corporate Recovery from the Financial Distress

Dr. Chuang-Min Chao, National Taipei University of Technology, Taiwan
Chia-Hsin, Wu, National Taipei University of Technology, Taiwan
bluewind0106@hotmail.com

ABSTRACT

Most of previous studies discussed the factors and indicators of financial distress (e.g., Williams and Nguyen, 2005), how to build a useful prediction model (e.g., Beaver, 1966), and which model has the best accuracy rate (e.g., Desheng, 2008). However, little discussion is on the factors that would lead a company recovers from a financial distress. Therefore, this study contributes to the literature by looking for factors or indicators that would make companies in Taiwan recover from the financial distress. The results will support researchers an innovative thinking to understand the characteristics of financial distress, the reasons why financial distress could be relieved, and the relationship between the economic climate and financial ratio. For managers, the results not only provide the related information of the financial distressed companies, but also help them to prevent and to solve the financial distress. For investors, the results can help them to understand the characteristics of the three types of the financial distressed companies and to discover the distressed companies at an early date, so as to reduce the damage.

Keywords: Financial Distress, Multinomial Logit Model

INTRODUCTION

The financial crisis of 2007–2008, initially referred to in the media as the "credit crunch" or "credit crisis", began in July 2007 when the loss of confidence by investors in the value of securitized mortgages in the United States. To deal with the liquidity crisis, the United States Federal Reserve and the European Central Bank injected a substantial amount of capital into the financial markets. The TED spread, an indicator of perceived credit risk in the general economy, spiked up in July 2007, remained volatile for a year, then spiked even higher in September 2008, reaching a record 4.65% on October 10, 2008. In September 2008, the crisis deepened, as stock markets world-wide crashed and entered a period of high volatility. There was a considerable number of banking, mortgage and insurance company failures in the following weeks. And a lot of companies face the financial distress due to this "financial crisis".

Financial distress is the most synthetic and notable distress for companies. With the gradually perfection of stock market mechanisms and bankruptcy laws, financial distress not only makes the company suffer great economic loss but also directly affects its survival and development. Besides, when many companies run into financial distress in the same period, it is possible to result in a new financial distress crisis in capital market. So how to help companies effectively predict financial distress has become a hot research topic in both academic and practical world. But, most important is that researches how the financial distress companies can recovery from financial distress.

In light of this,many previous studies discussed the factors and indicators of financial distress(e.g.,Williams and Nguyen, 2005; Kane, Richardson and Velury, 2006; Halpern, Kieschnick and Rotenberg, 2008), how to build a useful prediction model(e.g.,Beaver, 1966; Turetsky and Mcfwen, 2001; Pindado, Rodrigues and Torre, 2008), and which model has the best accuracy rate(e.g., Cheng, Chen and Fu, 2006; Desheng, 2008). However, the sample of most previous studies contains the financial normal firms and financially distressed firms and therefore they discuss the difference between financial normal firms and financially distressed firms and which factors lead to the financially distressed situation. Little discussion is on the factors that would lead a company recovers from a financial distress. Therefore, this study contributes to the literature by looking for factors or indicators that would make companies in Taiwan recover from the financial distress.

The sample contains the financially distressed firms during the period from June 30, 1997 through June 30, 2008. Three types financially distressed firms is defined in this study. Type-1 companies are those listed companies that experienced the financial distress but have been recovered. Type-2 companies are those listed companies that are under the financial distress. And type-3 companies are those de-listed companies. By using the multinomial logit model (MNLM), this study is going to identify the variables that could distinguish the three types of companies and find out the leading factors that make the type-1 companies recover from the financial distress.

The results will support researchers an innovative thinking to understand the characteristics of financial distress, the reasons why financial distress could be relieved. For managers, the results not only provide the related information of the financial distressed companies, but also help them to prevent and to solve the financial distress. For investors, the results can help them to understand the characteristics of the three types of the financial distressed companies and to discover the distressed companies at an early date, so as to reduce the damage.

The remainder of this paper is organized as follows. In Section 2 we provide background. The

methodology in Section 3 and summary and conclusions in Section4.

LITERATURE REVIEW

A study of financial distress

Because of the radical change in global economy, corporate financial failure prediction is playing an increasingly important role. Financial failure often occurs when a firm has chronic and serious losses and/or when the firm becomes insolvent with liabilities that are disproportionate to assets (Gestel et al., 2006). Corporate bankruptcy does not only to society as a whole. Therefore, accurate bankruptcy prediction models are of critical importance to various stakeholders, i.e. management, investors, employees, shareholders and other interested parties, as the models provide them with timely warnings.

There are various financial failure prediction models in the related literature. Early researches on financial failure prediction employ univariate approaches using ratio analysis (Beaver, 1996). Later, multivariate approaches combining multiple ratios and characteristics, such as linear multiple discriminant approaches (LMDA) (Altman, 1968; Altman, Edward,), logistic regression (Dimitras, Zanakis, & Zopounidis, 1996; Hua & Zhang, 2007), neural network (NN) (Lacher, Pamela, Sharma, & Fant, 1995), genetic algorithm (GA) (Shin & Lee, 2002) and expert systems (ESs) (Leonard, 1993), have been widely applied to corporate financial distress forecasting because of its universal approximation property and ability of extracting useful knowledge from vast data and domain experts. Because of Zmijewski (1984) found that most financial ratios does not comply with normal distribution, and the logit regression model can deal with this problem, therefore, multinomial logit regression model (Multinomial Logit Model, MNLM) is employed as a tool to discuss the reasons that Taiwan's corporate recover from financial distress.

In the financial distress studies, there are a lot of scholars used the logit regression to research (e.g., Martin, 1977; Ohlson, 1980), but there are a little scholars used the multinomial logit regression model to research (e.g., Jostarndt, 2007; Jostarndt and Sauther, 2008). And the Jostarndt (2008) used the multinomial logit regression model to analysis the determinants of firm exit and survival in financial distress, he found substantial differences in the economic impact of alternative types of exit, and he also found high ownership concentration reduces distress costs in that it fosters acquisition as the more preferable outcome of distress for a firm's shareholders and significantly shortens a firm's distress duration.

Cheng Wen-ying, Wu 1000 Hui, Lee Seung-young (2006) used multinomial logit regression model to explore the variables to distinguish between listed electronics industry and the listed plastics company' operating stages individual which include the operate normal, mildly crisis and severe crisis, and establish the listed electronics industry and the listing plastics industry financial distress early warning model individual.

Jostarndt (2008) used the multinomial logit regression model to analysis the determinants of firm exit and survival in financial distress; Cheng Wen-ying, Mr NG 1000 Hui, Lee Seung-young (2006) used the multinomial logit regression model to explore the variables distinguish between listed electronics industry and the listed plastics company' operating stages individual. In this study, we use the multinomial logit regression model (MNLM) to analysis the different of the three types financially distressed firms , and to find out the reason why the financially distressed firms can recover.

While previous studies usually categorize firms into healthy or distressed firms, this study categorizes the financial distressed firms into three types. From our study, we could understand the characteristics of these three types of financial distressed companies and we could understand the reasons behind those companies recovering from a financial distress.

The strategies of recovering form the financial distress

When companies face the financial distress, they can do the following strategies to recover from the financial distress.

The strategies of recovering form the financial distress can be broken down into five parts.

1. The negotiations about the financial distress

The business which faced bankruptcy wants to turn death into life can negotiations with their creditor. The result of negotiations could be: (1) postpone the creditor's right; (2) reduce a part of the creditor's right; (3) creditor obtains the operating right.

2. Restructure the business

Restructure the business can divide into six dimensions, including strategy, organization, procedures, technology, personnel and culture.

3. The strategies of tapping new resources when business run into financial distress

(1) Dispose the assets

When firms move into financial distress, sell or mortgage their assets can help the firms solve the problem.

(2) Increase the sales revenue

The insufficient is the main reason why the business runs into financial distress, so business must be devise a way to increase the sales revenue, i.e. exploit the new markets, look for the new customers and strengthen the marketing strategy, increase the electronic commerce.

(3) Look for collect funds

When business insufficient or liabilities have too much, the business may occur the financial distress. Then the primary method of solving problem is to collect funds. The methods of collect funds including (1) call for the shareholders pay the share which not received or additional equity, issue the new bonds to original creditor; (2) request for financial institution's help to protect the claims; (3) extend the credit and financing, and ease the pressure of capital insufficient; (4) use the method of seasoned equity offerings to have capitals from the shareholders.

(4) Capital decrease to redeem the loss

The meaning of capital, in general, for the limited liability company (Ltd.) is company by way of statutory procedure to eliminate the individual shareholder's return on equity (ROE) and make the stock lose its efficacy.

(5) Look for the help form government

When the business face the serious disaster, will harm the business' financial affairs, at this time, business may need the government's help.

(6) Merchant leasing instead of short-term loan

Because of the business lack for specialist to take charge of the financing situation and financial management, business deficient in the whole financing plan that it more easy to occur difficult to loan the funds. After the financial distress occurred, more often than not, as a result of guarantee insufficient and financial statement incredible, so they can not to raise funds form banks. At this time, business expect finance from the financial institution, it can merchant leasing instead of short-term loan form the leasing company.

4. The strategies of reducing expenses when business run into financial distress

(1) To cut down the expenses

After the financial distress occurred, various possible expenses must to survey it's possible of saving again, and then the business can save more capitals. The methods of cutting down the expenses, including reduce the management expenses, postpone extending the employee's fringe benefits, decrease in unnecessary an advertisement expenditures.

(2) To scale the scope down

Business must be close down the product line quickly which no future and unable bear losses, and don't invest in too much capitals about the problem child which have the

crisis factors.

(3) To adjustment the staff

After the financial distress occurred, if the business in difficult, then it can adjustment the staff, including (1) freeze the hiring, not fill vacancies in the event; (2) inter-departmental rotation; (3) limitations on overtime hours; (4) fixed-term contract labor(dispatch); (5) part of work personnel whose salary valuation is using the hours; (6) compulsory leave without pay; (7) take leave without pay; (8) reduced working hours; (9) reduce the salary; (10) deferred salary increases; (11) changes to the existing of the welfare system; (12) canceled year-end bonus; (13) transact the retirement early; (14) setting the high standard objectives to streamline the human.

(4) Recapitalization

The over capitalization is the main cause of bring about inappropriate capital structure, this is cause the fixed overweight burden which include bonds interests or preferred stocks interests, or inflation make the assets overvalue, then bring about the real profit insufficient. Therefore, business can use some methods, including (1) cut down the common stock or reduce particular stock par to abolish the water stock; (2) reduce the fixed amount of debt or lower debt interest rates to reduce debt the burden; (3) ransom particular stock which have high dividends, or convertible bond which can change the particular stock into common stock; (4) limit stocks and bonds additional various preferential terms.

5. The means of legal

(1) Disciplinary action

Disciplinary action by the Court made the compulsory order; its goal is to sustain the company's vitality.

(2) The legal order

During the business operating process, the business which occurred the loss and suffered failure can apply for seize to court through the creditor. At this time, business can shoot for the ahead of time to settle the financial distress; it can use the civil law to a higher court against the opposition to the original a judgment. In this period of time, it can to meet the urgent need through negotiation, or borrow money.

(3) Corporate reorganization

Reorganization is the instrument of the debtor’s; it can use to be the chips to creditor banks to exchange the time and negotiation. The definition of corporate reorganization is a limited liability company (Ltd.) issue the stocks or bonds in public, due to the financial difficulties and have been verge on pausing operation or have the dilemma of closing down, and it’s expected that have a reorganization possibility, under the supervision in the Court, adjust its interests of the creditors shareholders and other stakeholders to

make the company to maintain and rehabilitation.

The purposes of corporate reorganization are (1) clean-up debt--- protection of social interests of the public; (2) maintain the business operate---sound socio-economic unit. The reorganization could rescue form the business life, and can be good for the creditors, shareholders and other stakeholders, social economic and social security.

(4) Bankruptcy

Bankruptcy according to the "Bankruptcy law which is the legal procedure, when the debtor occur the difficult in the financial, and unable to repay all the creditors' debt, it in order to enable all creditors receive the appropriate treatment, and then it give the debtors a opportunity to reconstruction (renewable), and avoid the debt continued to increase, and to prevent the vicious collapse caused by the domino effect potential economic disorder.

The economic and financial environment intense turbulence, financial distress may occur at any time, in particular the global economy were affected by the financial tsunami, in order to avoid enterprises will not occur the management difficulties, bankruptcy, and closure by the financial distress, entrepreneurs must know that understanding the financial distress solved program, therefore, they will not occur the situation which they face the financial distress and then bushed, so they delay the time to deal with the financial distress, and get more injury. Understanding the financial distress management program is the course that entrepreneurs must take lessons in.

METHODOLOGY

Sample and data sources

The sample firms are those financial distressed firms based on the definition of the Taiwan Economic Journal (TEJ). The sample firms are those financial distressed firms based on the definition of the Taiwan Economic Journal (TEJ). It is the financially distressed firms when it occurred one of the listed below: (1) run bounced a check; (2) close down and bankruptcy; (3) HSBC views accountants signed; (4) reorganization; (5) relieve the difficult and seek to help; (6) takeover; (7) full stock de-listed; (8) financial constraints and lay-off; (9) negative of net income; (10) hollow and embezzle; (11) suspension of trading; (12) the chairman's check bounced; (13) bank's capital austerity; (14) serious loss; (15) recession and lay-off; (16) value stop-loss. Our sample is composed of the listed firms on the Taiwan Stock Exchange (TAIEX) which have incurred financial distress during the period from June 30, 1997 through June 30, 2008. Two hundred and eight-two companies are identified to incur financial distress during the sampling period, among which 49 are the type-1 companies, 73 belongs to the type-2 companies, and 160 are the type-3 companies. Three types financially distressed firms is

defined in this study. Type-1 companies are those listed companies that experienced the financial distress but have been recovered. Type-2 companies are those listed companies that are under the financial distress. And type-3 companies are those de-listed companies.

The data is collected for three for each sample company before the event date. The event date for the *type-1 companies* is the deal with financial distress's date, for *type-2 companies* is the June 30, 2008, for *type-3 companies* is the de-listed date. The data structure is shown on Table 1.

Table 1: Data structure

Type-1 companies are those listed companies that experienced the financial distress but have been recovered. Type-2 companies are those listed companies that are under the financial distress. And type-3 companies are those de-listed companies. N is the sampling data. The marginal percentage is the percentage of the total sampling data.

		N	Marginal Percentage
Y	Type-1 companies	49	17.4%
	Type-2 companies	73	25.9%
	Type-3 companies	160	56.7%
Total		282	100%

The model

The multinomial logit model (MNLM) analyzes the determinants of alternative outcome of distress as a discrete choice problem.[1] Formally, the MNLM can be written as

$$\ln \Omega_{m|b}(X) = \ln \frac{\Pr(y = m|X)}{\Pr(y = b|X)} = X\beta_{m|b} \qquad (1)$$

For m=1 to J, where J is number of categorical outcome and b is the designated base category, which is also referred to as the comparison group, and X is a vector of covariates. This study consider three outcomes, *Type-1 companies*, *type-2 companies*, and *type-3 companies*, i.e. *J=3*. The *type-1 companies* is the reference. Thus, the probability equations write:

$$\Pr(y = m|X) = \frac{\exp(X\beta_{m|1})}{\sum_{j=1}^{J} \exp(X_{\beta j|1})} \qquad (2)$$

The variables

[1] A more detailed description of the model can be found in Greene (2003), chapter 21.

Variable definitions

In this study, the dependent variable is classified into three main types: (1) Y=0, is the *type-1 companies*; (2) Y=1, is the *type-2 companies*; (3) Y=2, is the *type-3 companies*.

The independent variables are shown in Table 2, including the financial variables, and corporate governance variables. Financial variables are seasoning public offerings(X1), net non-operational ratio(X2), growth rate of the depreciable fixed assets(X3), account receivables turnover(X4), change in long-term debt(X5) , debt ratio(X6), capital(X7), and the gross rate of sales(X8). Corporate governance variables are cash flow rights(X9), board, CEO and CFO turnover (X10), and average director bonus(X11).

Table 2: Variables names and definitions

Table1 shows the independent variables and description and expected sign. And in the description, inside the parentheses are variable's units.

Category	Variables	Description	Expected sign
Financial Variables	X1	Seasoning public offerings (0/1)	+
	X2	Net non-operational ratio (%)	+
	X3	Growth rate of the depreciable fixed assets (%)	-
	X4	Account receivables turnover (%)	+
	X5	Debt ratio (%)	-
	X6	Change in long-term debt (million NT dollars)	-
	X7	Firm size (1000 million NT dollars)	+
	X8	The gross rate of sales (‰)	+
corporate governance variables	X9	Cash flow rights	+
	X10	Board, CEO and CFO turnover	-
	X11	Average of director bonus (ten trillion NT dollars)	-

Descriptive analysis

The descriptive statistics are shown in Table3.

Table 3: Descriptive statistics

Selected summary statistics on year-1, year-2, and year-3. The year-1 is the one year before event date; the year-2 is the two year before event date; the year-3 is the three year before event date. The data used for this study contains information on the full sample of 282 Taiwan companies. Variables are Seasoning public offerings(X1), net non-operational ratio(X2), growth rate of the depreciable fixed assets(X3), account

receivables turnover(X4), increase (decrease) long-term debt(X5) , debt ratio(X6), firm size (X7), the gross rate of sales(X8), cash flow rights(X9), board, CEO and CFO turnover (X10), and average of director bonus(X11).

	Year-1(n=282)		Year-2(n=282)		Year-3(n=282)	
variables	Mean	Std.	Mean	Std.	Mean	Std.
X1	0.120	0.321	0.120	0.322	0.170	0.376
X2	-212.620	2702.490	-85.290	496.729	-134.440	907.659
X3	51.150	614.084	34.360	400.060	13.930	106.907
X4	14.237	68.103	12.185	47.766	10.298	27.074
X5	70.412	32.630	63.404	24.819	58.388	19.646
X6	0.106	1.443	0.134	1.536	0.094	1.159
X7	0.298	0.714	0.298	0.714	0.298	0.714
X8	7.047	50.202	7.457	62.889	3.973	28.114
X9	18.782	14.809	19.294	14.431	20.567	15.167
X10	2.772	2.658	2.708	2.434	2.395	2.128
X11	0.127	0.552	0.081	0.548	0.158	0.691

Empirical results

Table 4 displays coefficients for multinomial logit regression model, their Likelihood Ratio Test χ^2, and measures of their explanatory ability. In *year-1*, higher seasoning public offerings(X1), net non-operational ratio(X2), firm size (X7), the gross rate of sales(X8), and cash flow rights(X9); lower growth rate of the depreciable fixed assets(X3), change in long-term debt(X5), and average of director bonus(X11) will increase the probability of recovery from financial distress. The accurate rate in this model is 64.9%.

Table 4: Results from multinomial logit regression (Year-1)

Maximum-likelihood estimates of multinomial logit models relating different outcomes of distress to a vector of explanatory variables. The year-1 is the one year before event date; the year-2 is the two year before event date; the year-3 is the three year before event date. The $Y_{1|0}$ means type-1 companies (Y=0) is the designated base category, when its variable was negative, the independent variable larger, the probability of companies recovery will higher; which is also referred to as the type-2.companies(Y=1).; $Y_{2|0}$ means type-1 companies (Y=0) is the designated base category, which is also referred to as the type-3 companies(Y=2). All variables definitions are from Table 2. *, **, and ***denote the parameters are statistically significant at 1%, 5%, and 10% level, respectively. The -2LL means -2 Log Likelihood, when the value larger, the regression model more fitness. The Likelihood Ratio Test χ^2 larger, the regression model more fit.

	Year-1			
	$Y_{1\|0}$		$Y_{2\|0}$	
	Coeff.	Sig.	Coeff.	Sig.
X1	-0.019	-1.166	0.022**	-1.166
X2	-0.005	-0.005	0.029**	-0.005
X3	0.012	0.010	0.001*	0.010
X4	-0.014	-0.002	0.374	-0.002
X5	0.003	0.018	0.003*	0.018
X6	0.307	0.433	0.220	0.433
X7	-0.150	-1.068	0.014**	-1.068
X8	-0.023	-0.002	0.083***	-0.002
X9	-0.022	-0.056	0.000*	-0.056
X10	0.131	0.070	0.258	0.070
X11	2.019	1.270	0.018**	1.270
Constant	0.310	1.276	0.036**	1.276
N(firms)	282			
Pseudo R^2	0.318			
-2LL	0.000***			
Likelihood Ratio Test χ^2	89.708			
Accurate Rate (%)	64.9			

Table 5 are shown that in *year-2*, higher cash flow rights(X9); lower board, CEO and CFO turnover (X10), and average of director bonus(X11) will lead companies keep the financial distress away. The accurate rate in this model is 61.7%.

Table 5: Results from multinomial logit regression (Year-2)

	Year-2			
	$Y_{1\|0}$		$Y_{2\|0}$	
	Coeff.	Sig.	Coeff.	Sig.
X1	-0.176	-0.767	0.237	-0.767
X2	0.000	0.000	0.608	0.000
X3	0.000	0.000	0.699	0.000
X4	0.003	0.000	0.502	0.000

X5	-0.001	0.007	0.383	0.007
X6	0.039	0.094	0.939	0.094
X7	0.075	-0.584	0.156	-0.584
X8	0.005	0.004	0.402	0.004
X9	-0.028	-0.040	0.003*	-0.040
X10	0.183	0.067	0.054***	0.067
X11	16.719	16.398	0.003*	16.398
Constant	0.290	1.502	0.008*	1.502
N(firms)			282	
Pseudo R^2			0.163	
-2LL			0.005***	
Likelihood Ratio Test χ^2			42.533	
Accurate Rate (%)			61.7	

Table 6 are shown that in *year-3*, higher seasoning public offerings(X1), account receivables turnover(X4), firm size (X7); lower growth rate of the depreciable fixed assets(X3) will increase the probability of recovery from financial distress. The accurate rate in this model is 60.6%.

Table 6: Results from multinomial logit regression (Year-3)

	Year-3			
	$Y_{1\|0}$		$Y_{2\|0}$	
	Coeff.	Sig.	Coeff.	Sig.
X1	-0.549	0.561	0.046**	0.561
X2	0.000	0.000	0.729	0.000
X3	0.002	0.012	0.001*	0.012
X4	-0.005	-0.017	0.038**	-0.017
X5	0.005	0.014	0.309	0.014
X6	0.243	0.474	0.378	0.474
X7	-0.029	-0.815	0.081*	-0.815
X8	-0.009	-0.004	0.558	-0.004
X9	-0.024	-0.020	0.102	-0.020
X10	0.071	-0.008	0.511	-0.008
X11	0.432	0.440	0.398	0.440
Constant	0.532	1.068	0.225	1.068

	Year-3			
	$Y_{1\|0}$		$Y_{2\|0}$	
	Coeff.	Sig.	Coeff.	Sig.
N(firms)	282			
Pseudo R^2	0.171			
-2LL	0.003***			
Likelihood Ratio Test χ^2	44.732			
Accurate Rate (%)	60.6			

As Campbell (1966) found that firm size and profitability are associated with emergence from corporate financial distress, we also find higher firm size and gross rate of sales are significant factors in recovery from financial distress. As Marek (2004) found debt ratios negative significantly correlated with financial distress, we also find lower debt ratios will increase the probability of recovery from financial distress.

The lower seasoning public offerings(X1) will increase the probability of recovery from financial distress, in *year-3,* may cause the pool performance companies often used the publish the seasoning public offerings to acquire the cash, the acts was not only changed the pool performance, but also damaged the companies' credit, therefore in increase the probability of recovery.

The higher net non-operational ratio(X2) will increase the probability of recovery from financial distress, in *year-1*,may cause the financially distressed firms lack for operational revenue, so they must be depend on the non-operational revenue to increase the income to keep the companies operate, and help the companies recovery.
The lower growth rate of the depreciable fixed assets(X3) will increase the probability of recovery from financial distress, in *year-1* and *year-3*, may cause the assets depreciation will reduce the companies' assets values.

The higher account receivables turnover(X4) will increase the probability of recovery from financial distress, in *year-3*, may cause the higher X4 means the account receivables and note receivables retrieve faster, it can help the companies to make use of finance.

The lower change in long-term debt(X5) will increase the probability of recovery from

financial distress, in *year-1*, may cause the higher X5 will lead the companies occur the insolvency.

The lower debt ratio(X6) will increase the probability of recovery from financial distress, in *year-1*, may cause the higher X6 will lead the gross of assets values lower, and the companies will easy occur the insolvency.

The higher firm size(X7) will increase the probability of recovery from financial distress, in *year-1* and *year-3*, may cause the higher firm size have more capital, so they can reduce the companies occur the insolvency.

The higher the gross rate of sales(X8) will increase the probability of recovery from financial distress, in *year-1*, may cause the higher X8 means the company sales increase, the market share increase, and the future is optimistic, therefore the companies will increase the probability of recovery .

The higher cash flow rights(X9) will increase the probability of recovery from financial distress, in *year-3*, may cause the X9 means the top stockholders real put up capital, so when companies occur the financial distress, the stockholders is or not have the force to support the companies, so the stockholder put up capital more, will increase the probability of recovery.

The lower board, CEO and CFO turnover (X10) will increase the probability of recovery from financial distress, in *year-2*, may cause the board, CEO and CFO turnover means the companies may occur the serious events, the companies may happen the condition, therefore the lower X10 will increase the probability of recovery.

The lower average of director bonus(X11) will increase the probability of recovery from financial distress, in *year-1* and *year-2*, may cause reduce the director bounds will reduce the companies expenditures, therefore the lower X11 will increase the probability of recovery.

SUMMARY AND CONCLUSIONS

The recovery form financial distress is of critical importance for managers, stakeholders and other parties related. In this literature, we focused on looking for factors or indicators that would make companies in Taiwan recover from the financial distress. We find that increase the seasoning public offerings(X1), net non-operational ratio(X2), account receivables turnover(X4), firm size (X7), the gross rate of sales(X8), cash flow rights(X9), board, CEO and CFO turnover (X10), and average of director bonus(X11) will lead companies keep the

financial distress away. Decrease the growth rate of the depreciable fixed assets(X3), increase (decrease) long-term debt(X5), and average of director bonus(X11) will increase the probability of recovery from financial distress.

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IMPROVING MANAGERIAL SKILLS – THE RESULTS OF RESEARCH DONE IN POLISH COMPANIES

Prof. dr hab. Agnieszka Sitko - Lutek, Maria Curie – Sklodowska University in Lublin, Poland
lutek@ramzes.umcs.lublin.pl

ABSTRACT

The paper presents the results of the research concerning managerial development. The process approach is taken into account with the following components: namely goals, planning, implementation and improvement evaluation. Conclusions identify that the model of improving managerial skills has a specialist character, there is the domination of traditional forms of development, the lack of systemic solutions in the organizations, concerning improvement resulting from the strategy and different approaches in various organizations.

Keywords: managerial development, developing managerial skills

INTRODUCTION

The era of globalization and the economy based on knowledge makes the managerial staff face an increasing number of expectations. Managers have to acquire new knowledge faster and more effectively. In the context of the economic crisis and the requirements of the environment such issues acquire a particularly vital role. Hence, it is worth trying to answer the question concerning the process of training the managerial personnel in Poland and the recommendations related to its improvement.

RESEARCH MODEL

Process approach to improving managerial skills makes it possible to identify the stages of the proceedings concerning the development of managerial staff and their mutual relationships. The model involves four elements, namely goals, planning, implementation and improvement evaluation. (1)

Within the goals, an identification of major orientations implemented in practice and preferred by the managerial staff was determined, which includes perfecting such types of training as:

- specialist versus general
- concerning the company itself versus specialist, technical
- functional versus managerial
- competencies versus relations

The level of the knowledge declared by the managerial staff was evaluated, as well as the elements requiring further improvement and improvement criteria which are necessary to assess the effectiveness of the undertaken process.
Another element of the model is planning such improvement within which special attention is paid to the time horizon of planning individual development and of initiating improvement in a company; the initiators and those responsible for the development of the managerial staff,

which is related to financing the refinement and the diagnosis of learning styles in order to adjust adequate forms and methods of improvement, as well as to increase the effectiveness of the actions undertaken.

The third element of the improvement model is implementation and it refers to specific aspects, such as forms and methods, both carried out and preferred within the improvement process; its subject matter; the intensity of the training and the role of the coach and the trainee.

Finally, the fourth element is evaluation, identifying previous experience in this area and references to the specified criteria, all of which will enable the evaluation of the course of the process up to now and its effectiveness. The results of the appraisal may provide a starting point to formulate new goals and they may affect the other elements of the model since the continuing development of the managerial staff is one of the key assumptions.
Perfecting managers is not a single act, however, and it does not occur in empty space, which means that there are a lot of organizational conditionings concerning in particular human resources management and systemic solutions in this area.

Hence, it is worthwhile pointing at a significant component determining the improvement of managerial skills, namely the organizational context which includes the company's strategy, its mission statement, the system of human resources management, the system of periodic appraisal, competence matrix, planning career paths or individual development plans and analyses of training needs.

RESEARCH METHODS

The study aims at creating a model of managerial development and diagnosing this issue in Polish organizations.

The model of managerial refinement includes elements such as: goals, planning, implementation and evaluation.

Scope of research - The study in Poland involved 750 managers representing over 30 businesses.

The basic research method used in the present study was a questionnaire.

The extent of the sample was determined by the number of managers in each of the studied companies.

Research method

The study was based on a questionnaire method. The questionnaire consisted of two parts. The first one was supposed to collect the information about the analyzed organizations and the respondents themselves, whereas the other one focused on improvement aspects. Sample selection was purposeful and the research included organizations representing different branches of industry, both traditional ones, such as mining or railways, municipal enterprises and construction companies and, finally, such groups of organizations whose market processes are most intensive, namely banks, telecommunication or the category of medium-

size, dynamically developing businesses. Following pilot research and a verification of the research tool, the adequate study was carried out among 30 companies on a total group of 750 managers of different rank.

Calculation methodology

The analysis of the interrelationships between categorized characteristics was performed with the use of χ^2 independence tests. The following results were obtained:

- Tables with size distribution,
- Values of χ^2 test function,
- Degrees of freedom corresponding to the test function,
- Probability related to the test function, used for comparisons with the significance level (0,05 or 0,01).

Within the calculation methodology applied, the results for different dependence coefficients were obtained, e.g. V-Cramer and C-Pearson contingency coefficient.

The analysis of dependency coefficient concerning learning styles was performed as follows:

- Descriptive characteristics were calculated for the coefficients of learning styles in the analysed groups of enterprises (e.g. median, standard deviation, standard error, coefficient of variation).

Statistical analyses were performed with the use of Statgraphics Plus v.5.1 program.

THE AIMS OF MANAGERIAL DEVELOPMENT

The analysis of managerial development aims took into account the objectives implemented and favored by the managerial staff, as well as the areas requiring further development and the criteria used to assess the improvement.

The first analyzed issue is identifying the aims of improvement.

Selecting **the aims** of managerial development implemented in the studied organizations and the preferences among the managerial staff, the following areas of knowledge and skills were considered:

a) Specialist or general,
a) About the company, or specialist, technical know-how,
b) Functional or managerial,
c) Competences or relationships, mutual relations.

a) specialist versus general development

Among the analyzed issues, the managerial staff assessed whether their attitude to development was dominated by the emphasis put on developing knowledge and skills of a specialist or general character. 83.09% of managers declared specialist development as prevailing in their companies, whereas 91.24% pointed to this approach as a preferred one. In each group of the studied companies the specialist attitude to development is dominating, regarding both the existing status and the preferred one. Additionally, in all groups of enterprises, except for telecommunication, the managers declared a higher preferred share of

specialist training courses in relation to the existing situation. No statistically significant dependence was noted between the type of the answer and the groups of enterprises, regarding the existing and the preferred objectives.

b) knowledge about the company versus specialist, technical know-how

81,66% of the studied managerial staff declared an attitude to development which was oriented to specialist and technical know-how, and 86.32% expressed their preference concerning such an approach. In assessing the existing and the preferred objectives, no statistically significant dependence was noted between the type of the answer and the group of companies.

d) functional versus managerial improvement

In the existing situation functional training dominates in 65.82%, while 51.43% of the studied managerial staff prefer managerial training.

The analysis performed among the managers in the studied enterprises suggests a prevalence of functional training courses in relation to managerial ones. The exception is the managerial staff in banks and medium-size developing enterprises. As far as the preferences expressed by the managerial staff of the banks, medium-size companies and telecommunication are concerned, managerial training is favored. The remaining groups prefer functional training.

Assessing the existing and the preferred objectives, a statistically significant dependence with $p< 0.0001$ was determined between the type of the response and the groups of companies.

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d) development oriented towards improving competences versus relationships, mutual relations

Among the studied managerial staff, 76.60% pointed at training oriented towards competence development, whereas this attitude is represented by 70.97% of the respondents as the preferred one.

Both in the existing and the preferred situation the managers declare dominance of development forms oriented towards improving competences to a higher degree than relations or mutual relationships. The assessment of the existing objectives revealed a statistically significant dependence between the type of response and the groups of enterprises, with $p=0.0062$, whereas no such dependence was noted for preferences.

The U test for fractions (frequencies) suggests statistically significant differences in the proportions of responses concerning the existing objectives in comparison with the preferred ones for $p < 0,001$ in the area of specialist or general development and managerial or functional improvement, and also for $p< 0.05$ in relation to the objectives of perfecting the knowledge about the company or specialist and technical know-how and competences or relations and mutual relationships.

An extremely useful tool in determining the objectives of managerial improvement may be provided by self-assessment of the knowledge and abilities possessed in particular areas, as well as identifying the areas which require further improvement (Table 1).

Table. 1. Assessment of managers' knowledge areas and skills and recommendations on further improvement

Areas of knowledge and abilities	Unsatisfactory	Satisfactory	Requiring further improvement
Specialist/ specific for the branch*	3.64	55.66	40.70
Management*	10.19	35.37	54.44
Human resources**	20.03	43.50	36.47
Finance**	28.44	27.56	44.0
Law**	28.36	22.39	49.25
Marketing**	26.17	29.77	44.06
Analytical skills	10.38	54.66	34.96
Technical skills *	14.95	53.12	31.93
Interpersonal skills**	9.35	50.53	40.12
IT **	17.93	30.27	51.79

** a statistically significant dependence was noted between the type of response and groups of companies, at $p< 0,001$
* a statistically significant dependence was noted between the type of response and groups of companies, at $p< 0,05$

The unsatisfactory note was most frequently given by the studied managerial staff to the level of knowledge and abilities concerning finance (28.44%), law (28.36%), marketing (26.17%) and human resources (20.03%), whereas the lowest number of choices was found for specialist know-how (3.64%) and interpersonal skills (9.35%).

Among the most satisfactory areas, the studied managerial staff pointed most frequently at specialist know-how (55.66%), analytical (54.66%), technical (53.12%) and interpersonal (50.53%) skills. The lowest number of satisfactory notes was given to law (22.39%), finance (27.56%), marketing (2977%), IT (30.27% and management (35.57%).

More than a half of the studied managerial staff declare a need to continue improving management (54.44%) and IT (51.79%), whereas over 40% of the respondents see a necessity to improve the knowledge concerning the area of law, specialist skills, marketing, finance and interpersonal skills. A relatively low percentage of managers (ca. 30%) want to develop their technical and analytical skills or the knowledge concerning human resources.

Additionally to assessing analytical skills, a statistically significant dependence between the type of response and the groups of companies was recorded, at $p< 0.05$ (specialist and technical know-how, knowledge of marketing) and at $p< 0.01$ for the remaining types of knowledge and abilities.

The highest share of managers declaring a satisfactory level of specialist knowledge was found among bank managers (71.19%) and managers in railway companies (61.73%), and the relatively lowest percentage was noted in mining (44.44%) where 50% of managers declare a requirement of further training in this sphere. Such a result may be related to very high technical and security requirements which are necessary in the mining industry and thus a higher level of technical skills needed in this particular industry in comparison to other businesses.

The level of knowledge concerning management was evaluated as unsatisfactory by the highest percentage of managers in construction companies (18.42%), public services (16.39%) and mining enterprises (13.33%), while the leader in the sphere of management was the managerial staff in banks.

The highest percentage of managers among public service companies (29.63%), telecommunication (27.12%), medium-size developing businesses (26.05%), construction (25%) and mining (21.01%) companies assessed their knowledge of human resources as unsatisfactory, while the best self-assessment was recorded among bank managers.

The highest percentage of managers among public service companies (37.74%), medium-size developing businesses (34.71%), construction (34.67%) companies assessed their knowledge of financial issues as unsatisfactory, while the best self-assessment was recorded among bank managers. 51.05% of railway managers declare a need for its further improvement.

The highest percentage of managers among medium-size developing businesses (32.77%), railway (32.09%) and mining (30.58%) companies assessed their knowledge of legal issues as unsatisfactory, whereas the highest rating was recorded among bank managers e(40.35%) and in telecommunication (35.71%). More than 50% managers in railway, construction and medium-size developing companies declare a need for its further improvement.

The highest percentage of managers among public service companies (35.59%), and mining companies (34.48%) assessed their knowledge of marketing as unsatisfactory, while the best self-assessment was recorded among bank managers (47.37%) and in telecommunication (44.44%). More than 50% of railway managers and about 40% of managerial staff in the remaining businesses declare a need for further improvement.

The highest percentage of managers among public service companies (18.18%), mining (14.75%) and construction (13.85%), companies assessed their level of analytical skills as unsatisfactory, while the best self-assessment was recorded among bank managers (67.86%) and in the remaining businesses – above 50%. Analytical skills are evaluated as relatively high in comparison with the remaining competences.

The highest percentage of managers among telecommunication companies (24.56%) assessed their level of knowledge of technical skills as unsatisfactory, while the best rating was recorded for railways (63.45%). Technical skills are evaluated as relatively high in comparison with other competences.

The highest percentage of managers among construction companies (21.54%) assessed their level of interpersonal skills as unsatisfactory, while the best scoring of above 50% was noted in mining companies, banks and medium-size developing businesses. Interpersonal skills are evaluated as relatively high in comparison with other competences.

The highest percentage of managers among railway enterprises (24.35%) assessed their level of computer skills as unsatisfactory, while the best score, 49.15%. was recorded in telecommunication companies. More than 50% of the managerial staff declared a need for further improvement in this area. Computer skills are evaluated relatively low in comparison with other competences.

Summing up, it can be concluded that the most satisfactory competence areas were identified as analytical, technical and interpersonal skills, as well as specialist know-how. The lowest marks were given to the spheres of functional knowledge concerning finance, law, marketing and human resources. The key issues requiring further development are the areas of management and IT skills. The results of the study provide a profile of a specialist manager equipped with traditional abilities and specialist know-how which may result to a high degree from experience. The weaknesses comprise using IT techniques and detailed functional knowledge areas where the least important area requiring further development is human resources or the issues of managing the human potential in an organization.

While identifying the objectives of managerial improvement it is necessary to determine evaluation criteria which are used in further stages of development. At $p<0.001$,a statistically significant dependence was noted between the type of response and the groups of companies, which concerned all categories of criteria, except for the usefulness of training in implementing professional assignments.

The most common criterion used to assess training is its usefulness in implementing professional assignments. Such usefulness was declared by 77.24% of the respondents. The criterion is most frequently used by banks.

The second most common criterion, applied in 47.93%, is the influence that training has on improving performance. It is used most frequently, in 61.65%, by the group of medium-size developing businesses and least commonly by public service companies.

Another criterion is the clarity and preparation of trainers. Yet the share this particular measure has in training evaluation is varied in different groups of enterprises. It has the highest significance in banks, 56.67%, and the lowest in construction companies (13.95%) and in railway (13.57%). In the remaining companies the value is at the level of ca. 20%.

The use of the criterion concerning the subject matter of the program is at the similar level. This particular measure was taken advantage of by 21.42% of the respondents, and the percentage in banks amounted to 46.67% and to as low as 9.3% among construction companies and 12.06% among railway organizations. In the remaining groups the managers evaluated the share of this criterion as used in about 20%.

Another criterion was the organizational form which was indicated by 11.38% of the respondents. It is applied as a measure in telecommunication enterprises in as much as 25.37%, and only in 6.03% in medium-size developing companies.
Merely 4.95% of the respondents declared that they were not using any of the criteria mentioned here.

The applicability analysis of different criteria in training evaluation revealed that among the studied enterprises it is banks that use the widest range of different standards. The prevailing criteria suggest a strong specialist orientation through emphasizing their usefulness in achieving professional goals and the performance as dominating while evaluating some initiated improvement.
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DEVELOPMENT PLANNING

While planning managerial development, one of the key factors which needs to be identified is time horizon.

In the analyses of the period of time for which one's individual development, career or training courses for the studied managerial staff the dominating length is 3 years (30.91%), next 5 years (24.90%) and 1 year (24.34%). 15.66% of the questioned managers declare the period of 10 years. A short time horizon of 6 months is taken into account by a very low percentage of the respondents, 2.94%, and that of one month by 1.26%. This means that the dominating time span in the temporal orientation concerning individual development is the period of 3-5 years. No statistically significant dependence was noted between the type of response and the groups of companies.

Planning individual development of managerial staff is related to the period of starting training and development in an enterprise. Most frequently, in 54.08%, training and development in companies is planned for 1 year, and in 26.00% it is decided ad hoc. Less frequently, 8.58%, it is planned in a 6-month perspective, in 5.81% for periods longer than 3 years, and in 5.53% for 3 years.

A statistically significant dependence was observed between the type of response and the groups of companies, at $p< 0.001$. In banks 91.67% of training courses are planned for 1 year. A similarly high share of 1-year-long plans is found in public service companies (58.91%), telecommunication (67.69%), medium-size developing businesses (58.91%) and railways (50.0%). Likewise, the policy in mining industry is carried out ad hoc (37.80%), as well as it amounts to 25.61% in construction companies. A relatively highest percentage of long-term planning, longer than 3 years, is noted in construction companies (14.63%) and in mining (12.6%).

Thus, there are two attitudes prevailing in taking up training courses. On the one hand, there is one-year planning, on the other hand ad hoc activities.

While planning managerial development, it is vital to identify the initiators of such processes and the individual responsibility of each member of the managerial staff for their activities leading to their individual development. The managers evaluated the activities they had initiated in order to improve their specialist knowledge indispensable for their particular position.

A statistically significant dependence was noted between the type of response and the groups of companies, at $p< 0.05$. The assessment of managers' activities undertaken in order to improve their specialist knowledge necessary on a given position is satisfactory. Such an approach was declared by 70.67% of the questioned managerial staff, especially among the employees of banks, public service and telecommunication companies.

25.18% of the respondents claimed that they had undertaken this type of activities, though in a more limited area. On the other hand, only 4.15% of the managers admitted that they had not been involved in such activities at all. A relatively highest percentage of negative answers was given by the managerial staff of the banks, railway and public service companies.

Another analyzed issue was an attempt to *identify the initiators of improvement processes in the organization.* In the highest degree, 30.33%, the development processes were initiated by the immediate superiors, in 19.11% of cases the initiators were the individuals interested themselves and in 16.07% the CEOs. A relatively high role is played by the management and Human Resources Directors, 14.27% each group. Hardly any recognition was given to training companies and training specialists.

In banks a significant role, apart from the immediate superior and the party interested, is played by Human Resources Directors. On the other hand, in construction companies the initiators are mainly their management boards and CEOs, similarly to public service companies in which direct superiors should be also taken into account. In railway companies development processes are initiated primarily by immediate superiors, 40.41%, and to a lower degree, though quite importantly, by the Human Resources Directors. In telecommunication companies the role of the Management Board in undertaking development activities is more significant compared to the role played by the CEO. Different results were obtained in medium-size developing businesses, where the vital role is played by Human Resources Director and the immediate superior.

A statistically significant dependence was observed between the type of response and the groups of companies, at $p < 0.001$. This means that initiating development processes is affected by the character of the industry.

A very important aspect concerning development planning is the source of its financing which may be the parties interested themselves, the company, or both. This reflects the company's responsibility for initiating development actions.

At $p < 0{,}001$ a statistically significant dependence was noted between the type of response and the groups of companies. According to the respondents, the burden of financing the development is put mainly on the company (60.46%) or is taken jointly with the trainee (34.56%) and only in 4.98% of cases the trainee has to pay for such an undertaking individually.

Financing is done in the largest extent by telecommunication, construction companies and banks, whereas in medium-size developing companies, railway and mining enterprises the organization has the lowest share, with a relatively high contribution of the participants themselves.

DEVELOPMENT IMPLEMENTATION

The first of the analyzed aspects concerning development implementation is its forms. Following the study, *an assessment of the domination of internal or external forms*. Most of the managerial staff, 64.16%, participated in training courses organized by external trainers and such a form is favored by 72.13% of the respondents. In relation to both the existing situation and preferences, a statistically significant dependence was recorded at $p < 0.001$ between the type of response and the groups of companies. In the majority of the studied companies, except for railways, the prevailing form is external training courses carried out by instructors from outside. This particular form is also much preferred among the managers of all the analyzed groups of enterprises.

The U test for fractions (frequency) suggests statistically significant differences in the proportions of the responses concerning the existing approach to development training in relation to the preferences in each of the studied areas, at $p < 0.001$.
The domination of the external forms of training may indicate a lack of internal training traditions or a lack of a well-qualified training staff which, as a consequence, means a deficiency of practical mechanisms of knowledge sharing and a low awareness concerning the necessity of corporate learning.

Another extremely interesting aspect of development is also classification whether the implemented or preferred forms of training may be judged as *structured* or not. The managerial staff assessed that 79.91% of the courses they had been offered were structured, whereas the preferences concerning this type of implementation were expresses by as much as 86.81%. No statistically significant dependence was noted in this sphere between the type of responses and the groups of companies.

While evaluating the implemented and preferred forms of development, a domination of *theoretical* or *practical* forms was identified. In the opinion of 61.30% of the managerial staff the courses they had participated in were theoretical, whereas 67.73% would prefer a practical form. Regarding the existing situation, at $p < 0.001$, a statistically significant dependence was observed between the type of responses and the groups of companies. Most managers, except for banks, evaluated their courses as theoretical, though they preferred a practical approach.

The study also included a *detailed analysis of development forms* undertaken by the managers so far and during the last few years (Table 2).

Table2. Forms of managerial development undertaken so far and during last 2 years (%)

Development forms	**So far**	**During last 2 years**
Post-graduate study	20.48**	16.33 **
Long-term training forms	15.93 **	11.24 **
Courses offering formal qualifications	25.97	20.75
Short-term training	40.16	38.69**
Training in the company	36.14	35.07 **
Seminars	23.56 *	22.89
Conferences	22.76	23.56 *
Training outside the company	29.85 *	30.92 **
Job rotation	11.11	6.29
Job observation	21.42	15.26
On the job training	23.03	16.47
Mentoring	1.74	1.34
Coaching	2.14	2.68
Self-development	36.81 **	27.18
Learning in action	35.07	27.58 **

** a statistically significant dependence between the type of responses and the groups of companies was noted, at $p < 0.001$
* a statistically significant dependence between the type of responses and the groups of companies was noted, at $p < 0.05$

The most frequently selected forms of training taken so far included short-term training (40.16%), self-development (36.81%), and the least popular forms were mentoring (1.74%), coaching (2.14%), job rotation (11.11%) and long-term training forms (15.93%). On the other hand, the analysis of the last two years suggests a relatively high share of short-term courses, courses organized within the company and external training. A detailed analysis of the individual groups of companies is presented in Table 31, annex, part IV. The highest participation in post-graduate studies was declared by bank employees (31.67%) and railway companies (27.14%) and the lowest by construction companies (9.3%) and medium-size dynamically developing enterprises (12.78%). Long-term training forms are most common among mining companies, and least popular in construction and telecommunication companies. The participation in courses offering formal qualifications is relatively similar in each of the groups of companies and amounts to 23-28%, whereas banks favor short-term courses (55%) and construction companies and medium-size developing businesses choose this form only in 34%. The highest participation concerning training courses organized in the company is declared by public service companies (ca.44%) and the lowest in construction companies (ca. 23%), compared to over 30% in the remaining groups. Seminars and conferences are forms preferred by the managers of public service and railway companies, though not popular in construction companies, medium-size developing businesses or banks. External training courses are most frequently chosen by bank managers, and least commonly by railway companies. Job rotation is relatively frequently used in banks and railway companies but it is rare in telecommunication, construction, mining and medium-size companies. Job observation is most often used in public service and medium-size developing companies, and least frequently in mining companies. On the job training is prevailing in banks, while its lowest share is observed in construction companies. Mentoring and coaching dominate in telecommunication companies, though the share of this particular form of development is relatively low and does not occur in banks at all. Self-development, similarly to learning in action, is most often applied in banks and medium-size dynamically developing businesses, and least frequently in construction and mining companies.

The structure of different forms of development referring to the last two years is similar.

The next issue analyzed in training implementation was development methods. For many years training methods were dominated by traditional teaching methods, lectures. The experience concerning *the use of activating methods* among the managerial staff in Poland goes back to the beginnings of the transformation period, and their source is dominated by the aid coming from foreign consultants. The studies on the training courses offered by the managers suggest a prevalence of active methods, which was declared by 58.87% of the managerial staff in question. As regards the training methods preferred, as much as 93.90% of the respondents point at active methods.

In the existing situation a statistically significant dependence ($p < 0.001$) was observed between the type of response and the groups of companies. The most common use of active training methods was declared by the managers of the banks, medium-size enterprises and telecommunication companies. Railways make an exception and the managerial staff in this sector used in 61.22% courses requiring only passive participation. On the other hand, the analysis of preferences shows that there is a lack of a statistically significant dependence between the type of responses and the groups of companies and confirms that the majority of managers in each group of enterprises is disposed towards active methods.

The level of the requirements concerning individual work after classes was assessed as well. 55.78% of the managerial staff evaluated their training courses as not requiring individual work after the classes. On the other hand, 60.28% of the managers would prefer the classes that would require such extra work. Both in the existing situation and in the preferences, a statistically significant dependence was noted, at $p < 0.001$, between the type of responses and the groups of companies. The majority of the managerial staff assessed their training courses as not requiring any further after their completion. The exception is medium-size developing businesses and telecommunication companies. The preferences are oriented towards courses requiring further work, although mining and public service companies favor the ones not requiring such individual work.

The respondents were also asked to choose *the best training methods* on the basis of the projects implemented so far (the details of the assessment are presented in Table 3).

The majority of the managerial staff in question (41.77%) claimed that the best training methods are games and simulations. High recognition was also given to group work (35.74%), discussions (35.21%) and case studies (33.87%). The least attractive form was diagnostic questionnaires (1.2%) and other (1.34%).
The analysis of the studied groups of companies shows that the approval of particular training forms depends on the type of the represented industry.

Table 3. The choice of the best training methods (%).

Training methods	Banks	Construc-tion companies	Mining	Public services	Railways	Telecommunication	Other	Total
Games and simulations	58.33	29.07	37.78	41.79	37.69	47.76	49.62	41.77**
Case studies	43.33	23.26	29.63	31.34	35.18	34.33	39.85	33.87
Role play	16.67	2.33	0.74	1.49	3.02	4.48	8.27	4.55**
Outdoor	16.67	3.49	0.74	4.48	3.03	4.48	12.78	5.76**
Presentations and demonstrations	5.0	33.72	20.74	37.31	29.15	20.90	22.56	25.03**
Diagnostic questionnaires	0	1.16	0	1.49	2.51	2.99	0	1.2
Brainstorming	31.67	19.77	31.85	26.87	23.12	25.37	27.07	26.24
Lecture	18.33	45.35	32.59	28.36	27.64	22.39	19.55	27.98**
Reading	1.67	10.47	5.93	7.46	10.05	5.97	5.26	7.23
Discussion	33.33	43.02	36.30	31.34	39.70	32.84	26.32	35.21
Group work	43.33	32.56	46.67	25.37	29.15	38.81	36.84	35.74*
Seminar	11.67	12.79	13.33	20.90	22.11	26.87	16.54	17.94
Behavior analysis from video tapes	18.33	10.47	5.19	10.45	11.56	5.97	11.28	10.17
Computer	15	17.44	17.04	7.46	11.06	14.93	15.04	13.92
Rother	0	1.16	0.74	2.99	1.51	1.49	1.50	1.34

** a statistically significant dependence between the type of responses and the groups of companies was noted, at $p < 0.001$
* a statistically significant dependence between the type of responses and the groups of companies was noted, at $p < 0.05$

Bank managers favor games and simulations (58.33%), case analyses, group work, discussions and brainstorming sessions.
The managerial staff in construction companies prefers lectures (45.35%) and discussions (43.02%), whereas the mining companies choose group work (46.67%), games and simulations (37.78%) and discussions (36.30%).

Public service companies give high marks to games and simulations (41.79%), as well as presentations and demonstrations (37.31%), while railways companies favor discussions (39.7%) and games and simulations (37.69%).

In telecommunication companies a high position is taken by games and simulations (47.76%) and group work (38.81%), while the managers in medium-size developing businesses prefer games and simulations (49.62%) and case studies (39.85%).

In the analysis of the traditional improvement methods which include *reading* specialist books 32.05% of the managers claim that they do not have time for such reading, which refers to 37.8% of the managerial staff in mining enterprises and 26.67% in banks. No statistically significant dependence was noted between the type of responses and the groups of companies.

Those who do read specialist literature choose items related to their particular industry (48.41%) or books on management (23.52%).

As regards reading specialist magazines related to work, 28.02% of the managerial staff in question do not find time for such reading. Those who read magazines prefer specialist ones related to their particular industry (59.2%), whereas only 13.6% read magazines on management. At $p = 0.0035$, a statistically significant dependence was observed between the type of responses and the groups of companies. The most active readers are bank managers, while reading is least common among the managerial staff in the mining industry.

The subject matter of training (Table 4) suggests that the analyzed managers participated in 50.33% in specialist training courses and in 34.0% in management courses. The lowest number of courses concerned the subject of law (8.70%), marketing (10.04%0 and Human Resources (10.71%). Among the managerial staff in the studied companies, bank managers declared the widest participation in different types of training, while the managers in construction companies had few opportunities to participate in training courses concerning other than strictly specialist ones (a similar structure occurs among public service , railway and mining companies – in this case, however, participation in courses in management is high and amounts to 41.48%). It should be also noted that the participation of the mining, construction and public service companies in training courses concerning Human Resources is rather low.

Table 4. The subject matter of training courses organized for the individual groups of companies

The subject matter of training	Banks	Construction	Mining	Public services	Railway	Telecommunication	Other	Total
Management	61.67	23.26	41.48	26.87	21.11	41.79	39.85	34.0**
Marketing	26.67	8.14	3.07	7.46	6.03	14.93	15.04	10.04**
Finance	38.33	8.14	23.70	14.93	9.05	16.42	21.80	17.40**
Human Resources	18.33	3.49	7.41	4.48	13.57	14.93	12.03	10.71*

Law	20.0	6.98	5.93	14.93	6.03	14.93	5.26	8.70**
Specialist/professional	53.33	46.51	51.11	59.70	54.27	50.75	39.85	50.33

** a statistically significant dependence between the type of responses and the groups of companies was noted, at $p < 0.001$
* a statistically significant dependence was noted between the type of responses and the groups of companies , at $p < 0.05$

Except for specialist courses individual for each industry which obviously dominate as the subject matter of the implemented training, in all other areas a statistically significant dependence was noted between the type of responses and the groups of companies.

In relation to the implemented training, a vital issue is training activity and intensity undertaken by the managers. Analyzing the participation of the managerial staff in training courses during the last two years, as much as 87.98% of the respondents declared their participation in such a form of activity.

At $p < 0.001$ a statistically significant dependence was observed between the type of responses and the groups of companies. Among the managerial staff in question, the training courses were most actively attended by the managers of the banks, telecommunication and medium-size developing companies, and the attendance was the lowest among the representatives of railways and construction companies.

The next studied issue was the intensity of the training. In 2001 the managerial staff in question took part most frequently (29.62%) in the courses lasting 3-5 days. Among bank managers longer training forms prevail and their share is balanced and amounts to over 22%. Construction companies prefer to implement short training forms, with 1-2-day-long courses dominating (33.87%).

Another analyzed issue was the intensity of the implemented training. In 2001 the managerial staff most frequently took part in training courses lasting 3-5 days (29.62%). Longer training forms are prevailing among bank managers. Their share is balanced and amounts to over 22%. Construction companies implement short forms with a prevalence of 1-2-day-long courses (33.87%). In mining and telecommunication firms the managers most commonly participate in 6-10-day long courses, while 3-5-day-long forms are popular among public services and medium-size developing companies.

The next element was the role of the trainer. On the basis of their training experience, 68.07% of the managerial staff in question decided that the teacher or *the trainer was the center of their attention.* As far as their preferences are concerned, 70.82% of the respondents would rather see the trainee as the center of attention..
While assessing the existing situation, a statistically significant dependence was noted between the type of responses and the groups of companies., at $p < 0.001$.

THE ASSESSMENT OF MANAGERIAL DEVELOPMENT

In the study the managerial staff were asked to assess the degree of their satisfaction of raising their qualifications in their companies.
At $p = 0.00014$, a statistically significant dependence was noted between the types of responses and the groups of companies.

Complete dissatisfaction concerning raising their qualifications in the company is expressed by 8.76% of the respondents, most frequently in construction companies (14.10%) and least frequently in telecommunication firms (1.52%). 18.22% of the respondents are rather dissatisfied and the largest groups among them are railway, telecommunication and construction companies (ca. 25% each), while the smallest group is represented by mining companies (9.92%).

20.17% of the respondents did not express any opinion on the level of their satisfaction concerning raising their qualifications in their companies.

The group of managers who are quite satisfied is the most numerous and makes 39.8%, while 13.77%. of the respondents are fully satisfied. The most numerous groups in this category are telecommunication (18.18%) and banks (17.24%).

Thus, it may be concluded that 26.89% of the managers are not satisfied with raising their qualifications in the company, whereas 52.85% of the respondents express their satisfaction.

The next studied area was training usefulness. The assessment of the implemented training courses seems to be satisfactory. 79.13% of the respondents believe that the courses they had attended were useful. In the existing situation, a statistically significant dependence ($p < 0.001$) was observed between the types of responses given and the groups of companies. The highest usefulness of the implemented training in the opinion of the managerial staff was declared by the respondents representing telecommunication companies (91.94%), while the relatively lowest was expressed by the employees of railway companies (70.92%). Regarding their preferences, there is no statistically significant dependence between the type of responses and the groups of companies.

While analyzing development, the attractiveness of training was evaluated. The questioned managers shared in 73.94% the view that the implemented training courses were interesting. In the existing situation, a statistically significant dependence ($p < 0.001$) was observed between the type of responses and the groups of companies. The highest share of interesting courses was found in telecommunication (86.89%) companies, banks (85%) and medium-size developing businesses (84.92%), while the relatively lowest share was among railway (60.10%) and mining companies (69.53%).

The next issue concerning the approach towards improvement was the assessment of satisfaction level. 69.29% of the respondents evaluate their courses as satisfying and 86.10% declare the same in their preferences. In the existing situation no statistically significant dependence ($p < 0.001$) was noted between the types of responses and the groups of companies. The majority of the managerial staff decided that the training courses had been satisfying, which was expressed to the highest degree (80.95%) by medium-size developing businesses, and to a relatively lowest degree by railway companies. In relation to their preferences, no statistically significant dependence between the type of responses and the groups of companies was observed.

The respondents also evaluated the effect of the training on improved performance. In the opinion of 67.71% of the respondents the implemented courses did improve the performance, and the preferences favoring such a situation were expressed by 83.73% of the respondents. In the existing situation, a statistically significant dependence ($p < 0.001$) was observed

between the type of responses and the groups of companies. The majority of the managerial staff claimed that the implemented courses influenced the performance, to the highest degree in medium-size companies and to the lowest extent in railway and mining companies.

CONCLUSIONS

The conclusions from the study on improving managerial skills:

1.*The model of improving managerial skills has a specialist character,* which is confirmed by both the aims of their activities so far and the preferences regarding the continuation of such an approach. The specialist orientation is also confirmed by a relatively high self-assessment of the managers concerning their knowledge and specialist qualifications as compared with other areas of knowledge. The dominating type of training courses is that on specialist issues or courses in management.
Organizational solutions support the model of a specialist manager since the professional knowledge and specialist skills make the most significant criterion of job promotion.

2. *The domination of traditional forms of improvement*: theoretical, one-time, discontinued, not followed by one's independent work after completing the course, external, short-lasting, coach-oriented. There is a relatively low share of modern methods, such as mentoring, coaching, job rotation or long-term forms of training. This can be accounted for by either being unaware of the existence of modern forms of improvement or a lack of competent implementers, or by cultural barriers. It should be also noted that the managers involved in the study were reluctant to undertake self-assessment, which was expressed by their low acceptance level concerning questionnaires used as a method of improvement.

3. *The declared active forms of improvement*, though of a relatively low intensity, which is also confirmed by the choice of games and simulation, group work, discussions and case analyses.

4. *The lack of systemic solutions in the organizations, concerning improvement* resulting from the strategy, the lack of an integrated system of human resources management with mutually related elements, such as adaptation, periodic appraisal, development planning or competency matrix and improvement. Organizational solutions do not promote improvement and development, which is reflected by the criteria of promotion, where completing a training course or the results of periodic appraisal are among the least important factors.

5. *The key role and responsibility of immediate superiors* in initiating improvement, together with a marginal role of personnel departments and their employees. This is confirmed by the lack of awareness concerning the role of perfecting and a deficiency of systemic solutions supporting such processes. Also, it is proved by a very conservative treatment of personnel services which are reduced to administrative activities rather than co-creating and implementing the development of human resources. Decision-taking competencies related to improvement are concentrated on the top level of the board of managers. Another significant aspect while appraising the role of immediate superiors is their influence on creating social capital in organizations, based on trust. The cultural circumstances concerning the authority's big distance and collectivism may support trust and be used in order to develop methods of internal improvement, rather than just employing external coaches. However, such an attitude

will require new competencies in managers who will share the responsibility for learning processes of their subordinates, teams and the whole organizations.

6. The studied organizations reveal *a significantly varied attitude to improving managerial skills*. The groups of enterprises which are best adapted to the market conditions or have the longest experience in this area belong to the leaders in improving their managerial staff. The following groups of companies can be distinguished:

- Banks – leading in the area of implemented activities related to improvement, and, to a lower degree, telecommunication companies and a group of medium-sized, dynamically developing enterprises. They are characterized by their engagement in a long-term development, the highest training activity and the best-developed organizational solutions regarding the system of human resources management where the policy of improvement and development makes an integral element combined with periodic appraisal, development planning etc. In this group of enterprises, the improvement process is based to the highest degree on a rational cycle which starts with an analysis of training needs and finishes with an evaluation with the widest range of evaluating methods.
- A particular group, as far as the approach to improving managerial skills is concerned, comprises public companies characterized by an apparent paradox. On the one hand such enterprises most firmly declare the cultural patterns of being people-oriented, which could suggest the best practice possible regarding the sphere of human resources management. Yet the reality is completely different, which is illustrated by the companies' relatively low training activity and the domination of specialist approach. At the same time, the studies show that the financial situation does not make a barrier for undertaking the activities leading to improvement. Thus, we get a picture of enterprises representing a slightly archaic, very traditional attitude to managing their social potential, based on paternalistic patterns. The actual development of the people and their competencies is limited to mandatory training courses, most often specialist ones, and the substantial criteria are of secondary role, whereas orientation towards people is reflected merely in the expanded sphere of social benefits rather than in a mature preparation of the staff and their competencies to handle the complex, changing reality and to become competitive.
- The third group of enterprises is made by the most traditional representatives including railways, mining industry and construction companies. In this group the activity related to managerial staff improvement has the most limited range which is reflected by their relatively low training activity, poor participation in training courses, joining such courses *ad hoc*, without any planning and with no reference to the organization's strategy. The courses completed are also evaluated in comparison with the other groups of enterprises as the least attractive and having hardly any effect on improving their performance. The subject matter of the courses they select is mainly of specialist character and it is frequently supported by traditional methods of their implementation, such as lectures which are dominating among the representatives of construction firms. The situation concerning improvement strategies in this particular group of enterprises may be explained by the hard period these branches are experiencing and by deficiencies in the sphere of management, e.g. a lack of a strategy, or finally, by a difficult financial situation which refers particularly to railways.

7. Positive tendencies are represented by the fact that *preferences regarding improvement may indicate the directions for changes and a growing awareness of the role of developing* the potential of human resources in modern organizations. This refers to such issues as the continuity of improvement, individualization, orientation towards the learning person,

growing activity, pragmatism and a higher share of goals oriented towards building managerial relations.

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AN EVOLTUIONARY COMPLEX SYSTEM'S DECISION-SUPPORT TOOL FOR THE MANAGEMENT OF OPERATIONS

Dr James S Baldwin
School of Management, University of Sheffield
9 Mappin Street, Sheffield, S1 4DT, United Kingdom
j.baldwin@shef.ac.uk

Professor Peter M Allen
Complex Systems Management Centre, Cranfield University
Bedford, MK43 0AL, United Kingdom
p.m.allen@cranfield.ac.uk

Professor Keith Ridgway
Advanced Manufacturing Research Centre with Boeing, University of Sheffield
Advanced Manufacturing Park, Wallis Way, Catcliffe, Rotherham, S60 5TZ
k.ridgway@shef.ac.uk

ABSTRACT

This research aimed to add both to the development of complex systems thinking in the subject area of Operations and Production Management and to the limited number of applications of computational models and simulations from the science of complex systems. The latter potentially offer helpful decision-support tools for operations and production managers. A mechanical engineering firm was used as a case study where a combined qualitative and quantitative methodological approach was employed to extract the required data from four senior managers. Company performance measures as well as firm technologies, practices and policies, and their relation and interaction with one another, were elicited. The data were subjected to an evolutionary complex systems model resulting in a series of simulations. The findings included both reassuring and some unexpected results. The simulation based on the CEO's opinions led the most cohesive and synergistic collection of practices describing the firm, closely followed by the Marketing and R&D Managers. The Manufacturing Manager's responses led to the most extreme evolutionary trajectory where the integrity of the entire firm came into question particularly when considering how employees were utilised. By drawing directly from the opinions and views of managers rather than from logical 'if-then' rules and averaged mathematical representations of agents that characterise agent-based and other self-organisational models, this work builds on previous applications by capturing a micro-level description of diversity and a learning effect that has been problematical not only in terms of theory but also in application. This approach can be used as a decision-support tool for operations and other managers providing a forum with which to explore a) the strengths, weaknesses and consequences of different decision-making capacities within the firm; b) the introduction of new manufacturing technologies, practices and policies; and, c) the different evolutionary trajectories that a firm can take.

Keywords – Diversity, decision-making, evolutionary complex systems, modelling and simulation, organisational evolution

INTRODUCTION

Supply networks, organisations, individuals and their decision-making processes are increasingly being viewed and treated as complex systems (Choi et al., 2001; Frizelle and Woodcock, 1995; Macbeth, 2002; MacIntosh and MacLean, 2001; McCarthy, 2003). There has also been a growing trend recently, and particularly during the last decade or so, in the modelling and simulation of such systems (Chaharbaghi, 1991; Islo, 2001; Li et al., 2003; Lim and Zhang, 2003; Nilsson and Darley, 2006; Zhou et al., 2003). This research aims to build on this and add to both the theoretical development of complex systems thinking in the subject area of Operations and Production Management and, perhaps more so, to the limited number of applications of computational models and simulations which offer potentially effective decision-support tools (Macbeth, 2002; McCarthy, 2004; Nilsson and Darley, 2006).

With complex socio-economic systems, evolution and change are inevitable and the performance and survival of a firm is largely determined by its management of change (Jarratt, 1999; Macbeth, 2002; McCarthy, 2004); and with manufacturing firms, technological change in particular (Raymond et al., 1996). However, change management is fraught with problems not least getting everyone 'singing from the same song sheet'. For example, there has long been a recognition of the differences in motivations, interests and priorities of managers from different functional areas (O'Leary-Kelly and Flores, 2002; Rhee and Mehra, 2006) which if not managed appropriately, in terms of strategic alignment (Skinner, 1969), can be a significant detriment to firm performance (Malhotra and Sharma, 2002). This has prompted calls for decision-support tools that increase understanding of the underlying processes in the adoption and implementation of new technologies (Baldwin et al., 2005; Das and Narasimhan, 2001; Klassen and Whybark, 1999), practices (Cua et al., 2001; McKone et al., 2001; Zhu and Cote, 2004; Zhu et al., 2008) and policies (McCarthy, 2004; O'Leary-Kelly and Flores, 2002) within the context of the firm's strategic emphasis both corporate and functional (Brown et al., 2007; Leachman et al., 2005). The role and importance of management decision-making in organisational evolution can not be underestimated. Raymond et al (1996), for example, whilst investigating technology adoption in SMEs, identified the decision-making process as one of three main profiles of strategic advantage along with technological expertise and organisational capabilities.

Two approaches in the development of decision-support systems, theoretical and computational modelling, are evident in the literature. For example, Karkkainen and Hallikas (2006) explored, via case-study, the dynamics of inter-organisational network-related decision-making under a series of scenarios relating to risk management, learning and the business environment. They pointed out that not only was there a dearth of research in management decision-making processes underlying organisational change but that a holistic and systemic approach was needed to fully understand both intra- and inter-organisational decision-making. In remedying this, Meade et al (2006) applied the theories of chaos and complexity to provide an understanding of the decisions behind formulating strategies for the successful positioning of products in the technology adoption life-cycle. Using several case studies of firms within the ICT industry, this work successfully demonstrated the usefulness of this approach. In terms of computational modelling, Lim and Zhang (2003), Zhou et al (2003), and Nilsson and Darley (2006) applied agent-based modelling and created virtual factories to not only further understanding in the change management process but also to create a decision-support tool in the form of 'what-if'

scenarios where the consequences of particular decisions could be analysed and evaluated. Agents in these applications typically represented different machines, sales, operations planning, warehousing, and customers. Nilsson and Darley's (2006) work is important not only for providing a rationale for the use of the complex adaptive systems perspective, but also for being the first study to produce empirically verified results of agent-based models in the subject area of Operations and Production Management. At a level of aggregation higher, Kaihara (2003), created a virtual market and explored strategies in a supply chain model based on a problem of resource allocation within a dynamic environment. The aim again, which was largely successful, was to develop a decision-support tool to most effectively optimise supply chain performance.

Whilst acknowledging that management decision-making is central to any organisational change/transformation, there is also rising awareness of the impact of diversity in the decision-making process (Allen et al., 2006; Poundarikapuram and Veeramani, 2004). Diversity, in the context of this research, refers not only to the different decisions that can and are made but to the range of approaches taken when decision-making due to individuals' different perspectives, beliefs, attitudes and information-processing capacities/abilities (Allen et al., 2006). Simon's (1955; 1983) notion of bounded rationality from the cognitive sciences and more recently evolutionary economics, which refers to the incomplete knowledge that people have and use (and misuse) when decision-making, is also relevant here (Nilsson and Darley, 2006). Getting a balance is key, as diversity is seen as being hugely advantageous in terms of innovative capabilities if set within a conducive organisational culture (Jarratt, 1999). It also has the potential to radically affect the evolution of a company particularly in times of change, for example, when introducing a new technology, practice or policy (Baldwin et al., 2005; Jarratt, 1999). However, capturing this level of diversity has been problematical not only in terms of theory (but see, for example, Holland, 1995; Jantsch, 1980; Prigogine and Stengers, 1987) but also, and perhaps more evidently, in application.

Evolutionary complex systems modelling departs from the other computational modelling techniques, such as system dynamics, agent-based and other self-organisational models, as it incorporates the role and influence of *micro-diversity* along with experiential learning which are arguably the driving forces and impetus behind *evolutionary*, rather than merely *adaptive,* change (Allen et al., 2006). Evolutionary complex systems theory is a European branch of complexity thinking stemming from Prigogine's (1973) Nobel Prize winning work. The approach has now been successfully applied to ecosystems, urban systems, economic markets and, more recently, in evolving an entire industry (Allen et al., 2005; 2006; 2007; Baldwin et al., 2005).

To illustrate the differences between the different systems models a consideration of underlying assumptions is needed. Modelling assumptions create a hierarchy of models from known certainties and perfect prediction through to explorations of the unknown and the least-likely of potentialities (Allen et al., 2007). All systems models have at least two assumptions: 1) that a boundary exists between the system, in this case the firm, and its environment, and 2) that the system's components, e.g., the firm's technologies, practices and policies, can be classified to produce a taxonomy.

Additional assumptions concern the system's components and their interactions. System dynamic models have components and interactions that represent the average. When everything has been averaged there is just one future path – the most probable. These models give the impression of complete understanding and knowledge, and in turn perfect predictability. But what do average components and interactions actually mean when applied to a firm? Take, for example, the implementation of line-balancing or empowering employees. Not every firm has the same approach. Indeed, if every firm's approach was scrutinised, there would be a high degree of idiosyncrasy. Furthermore, and in terms of interaction with other components (e.g. quality or inspection policies), not all implementations of line-balancing and/or empowering employees have the same outcomes. That is, what would work in one organisation, or even one point in time, may not necessarily work in another.

By introducing the non-average, the nature of the model begins to change from certainty and prediction to exploration and potentialities. Through the inclusion of all the potential types of interactions that can occur, models can begin to explore and reach many possible future scenarios through self-organisational processes (e.g. the different outcomes of line-balancing or employee empowerment implementation in the example above). The few complex system computational models found in the literature are of this type (see, for example, Chaharbaghi, 1991; Islo, 2001; Kaihara, 2003; Li et al., 2003; Lim and Zhang, 2003; Meade et al., 2006; Nilsson and Darley, 2006; Zhou et al., 2003). Although highly useful both practically and intellectually, there is, nonetheless, a limitation to these models particularly in their application to social systems. To represent diversity, these models have a stochastic mechanism that generates 'noise', which is certainly more realistic than assuming only average conditions and interactions. However, whilst these models introduce non-average interactions, the components or, in another word, agents are still of an average type that are subject to a pre-defined, 'if-then' rule-based system. The noisy interaction of 'average' elements does not have the same outcome, or spread of outcomes as the interaction of diverse, heterogeneous individual elements. In the former case we may see different configurations or regimes of operation appearing, but in the latter case, new combinations of different elements leading to new, emergent capabilities and dimensions of performance can occur. This is the essential characteristic of evolutionary change – a process of qualitative, not just quantitative, change.

It is heterogeneous components that distinguish evolutionary complex systems models from self-organisational models (Allen et al., 2007). Representing all possible types of components, through the introduction of internal or micro-diversity, as well as all possible interactions produces a more realistic representation of true evolutionary processes. Whilst blind adaptation is associated with self-organisational models, evolutionary complex systems models mimic co-evolution through experiential learning. Control devolves fully from the global/system level to the local/individual level and is an expression of singular behaviours and their performance and success relative to others within the system; evolution proceeds through fully de-centralised, rather than centralised, decision-making. In addition, evolution, being an open process, ensues through a combination of both the determinism of the individuals' purposefulness but also by chance events. The intake of new kinds of individuals, or the changing views and thoughts that they may have is not a rational, calculated process because the implications of any particular heterogeneity is not known until after an evolutionary step has occurred in system behaviour. In this way, the evolution that does occur is not really predictable but results from the interplay of

individual heterogeneity and the differential performances of the resulting organisations. This is largely characterised by an inevitable lack of pre-existing knowledge of the link between individual and system behaviour and can be thought of as resulting from a degree of 'error-making' (Allen et al., 2006). The role of chance is fundamental, however, creating a rich medium for experiential learning through ceaseless experiments in behaviour space (Allen et al., 2007). As the approach incorporates diversity at all levels of description, it is arguably the most appropriate when trying to attain a better understanding of the role of diversity in decision-making and the impacts on a firm's evolutionary trajectories.

RESEARCH METHODS

To develop an evolutionary complex systems model which simulated a firm's evolutionary trajectory reflecting management assumptions was achieved by: a) building a profile of a company through a case-study approach involving observation and semi-structured interviews; and then b) gauging, via a quantitative questionnaire, the managers' perception of how the firm's technologies, practices and policies interacted with one another. In so doing, it was possible to compare and contrast different decision-making capacities which enables an exploration of decision-making consequences resulting from potentially diverse information sources and belief-systems.

The case-study approach was selected to better illustrate and exemplify the utility of the evolutionary complex systems modelling technique (Eisenhardt, 1989; Meredith, 1998) and is consistent with similar research (Meade et al., 2006; Nilsson and Darley, 2006). As is common with case study research, sampling was purposive (Saunders et al., 2007). That is, a number of firms were pre-screened to determine whether they had a suitable profile that would help achieve the research aim. A mechanical engineering firm was approached and consented to act as the case study. The CEO, and three senior managers, responsible for Marketing, Manufacturing, and R&D, participated.

Interviews were based on a semi-structured qualitative questionnaire. To maximise the internal validity of the questionnaire (Saunders et al., 2007), the interview schedule was first piloted on two industrialists and an academic familiar with Operations and Production Management after which small adjustments were made. Interviewer and interviewee biases were minimised through the selection of neutral settings for interviews and through a standardised presentation of non-leading questions (Saunders et al., 2007). The interview schedule was designed to: a) enable a discussion of what the participants deemed important for the survival of the company in terms of performance; and b) encourage an exploration of what characterised the company in terms of the firm's technologies, practices and policies (henceforth referred to as 'character-states') covering, for example, the workforce, suppliers, quality, R&D and factory layout.

From the interviews, four main performance criteria, i.e., product quality, cost efficiency, relationships with clients, and schedule adherence, and 25 company character-states (listed in table 1) were identified and provided the basis for a quantitative questionnaire. The performance criteria are consistent with both the literature and previous empirical research on manufacturing performance (see, for example, Brown et al., 2007; Cua et al., 2001; Das and Narasimhan, 2001; Fynes et al., 2005; Skinner, 1969). The character-states are also consistent with the literature and

previous studies (see, for example, Baldwin et al., 2005; Leseure, 2000; McCarthy et al., 1997; Womack et al., 1990).

Table 1 - Company character-states (CSs): Number and description

No.	Description	No.	Description
1	ISO 9000	14	ERP system (organise/monitor resources)
2	Materials purchasing standards	15	Full resource visibility
3	100% inspection	16	Setup automation
4	Selective preventive maintenance	17	Cells with automated equipment
5	Decentralised error detection and correction	18	Setup time reduction
6	Outsourced corrective maintenance	19	Resource priority control
7	5S's programme	20	24 hour production
8	Proactive annual training	21	Production process traceability
9	Employee multi-skilling	22	MRP system (material replenishment)
10	Line-balancing	23	ERP customer integration
11	Job rotation	24	Supplier co-operation
12	Flexible workers	25	R&D Investment
13	Empowering employees		

*Note: 'character-states' will be abbreviated in the text to 'CS' when referred together with a particular technology, practice or policy; for example 'CS1, ISO 9000'

The questionnaire was designed to gather the senior managers' views of how the 25 character-states interacted with one-another in relation to the overall performance of the firm. Piloting, involving two academics and two industrialists, was in two stages after which incremental adjustments were made to the questionnaire to ensure construct validity (Saunders et al., 2007). The final questionnaire had three parts. The first asked participants to rank the overall importance of the four performance criteria to the company, for example, 1st: external relationships; 2nd: schedule adherence, and so on. The second part asked participants to rank the impact or strength of association of each of the character-states on each of the performance criteria; for example, CS1, ISO 9000, may be associated 1st with product quality, 2nd with relationships with clients, 3rd with cost efficiency and 4th with schedule adherence, etc. These first two sections aimed to provide a basis for weighting mechanisms in the model as some character-states impact particular performance criteria more than others. The final part of the questionnaire asked participants to gauge the interactions between each of the character-states in terms of the overall performance of the firm. The answer options were based on a 7-point Likert scale (-3 to +3) determining the degree of positive/neutral/negative interactivity. That is, participants could indicate a moderately synergistic interaction between, for example, CS1 and CS2 as '+2' and a strongly antagonistic interaction between CS1 and CS3 as '-3' and so on. The evolutionary complex systems model drew directly from this latter questionnaire part.

SIMUALTION MODEL

The model was designed to simulate the interaction between the firm's character-states drawing directly from the four decision-makers' perceptions, values, and beliefs, etc. The model is based on a mathematical expression that describes how a change can occur and a new behaviour be adopted in a system (Allen et al., 2007). Behaviours may represent for example new species in a natural ecosystem or the introduction of new technologies, practices and policies in a manufacturing firm. A new practice or behaviour can only grow in the system if the system is

unstable to its appearance and this therefore gives a mathematical expression corresponding to its growth or decline. This allows the model to explore how the selection mechanisms will respond to any particular succession of new practices or behaviours, as this evolutionary process will only allow the retention of certain, effective bundles of practices and behaviours. These emergent bundles of practices and behaviours will experience positive feedback and growth when their particular characteristic performances correspond to that which the selection environment requires. These might be, for example, increased sales, quality, productivity and adherence to schedules, and the selection environment will ensure that the appropriate assemblages of practices and behaviours will emerge. It is through this parallel pursuit of multiple possible pathways that the potential customers' requirements and, at the same time, organisations capabilities will be created that achieve what is required.

If firms do not experiment with new practices and behaviours, then they will be "outrun" by at least some of those that do, and will be eliminated. However, it is the ignorance and uncertainty about the effectiveness and outcomes to be expected from different combinations of practices that mean that different sequences will be tried and different bundles emerge. On the other hand, if firms try out too many new practices and behaviours at the same time, then there will be an internal competition between different possible organisational structures and emergent performances and so this too will be eliminated in a competitive system. In addition, the fact that there will be any emergent successful capabilities is not known until after it has occurred and so if repeated launching of new practices and behaviours does not create new, successful production then it is time to move investment to other things. This model captures the idea that experimental explorations will either discover and create market niches or that there do not seem to be any and the investment is wasted. Evolution of the system is either retained in exploring and finding potential demand hidden in a particular domain, or it will move on to another domain.

The model is based on the equations given in Allen et al (2007), developed in Turbo Basic® and run in the Microsoft Dos® operating system. Several variables can be manipulated and calibrated, three of which require more explanation. The first is the running time of the simulation. This may be adjusted to permit finding stable solutions which are typically found within 10-50,000 arbitrary time units. The second variable is the number of character-state initiations in the model which allows exploration of particular organisational forms. The third is the performance value of the character-state. Values may lie between 0-30 arbitrary units. The higher the value the better the performance and importance within the organisation.

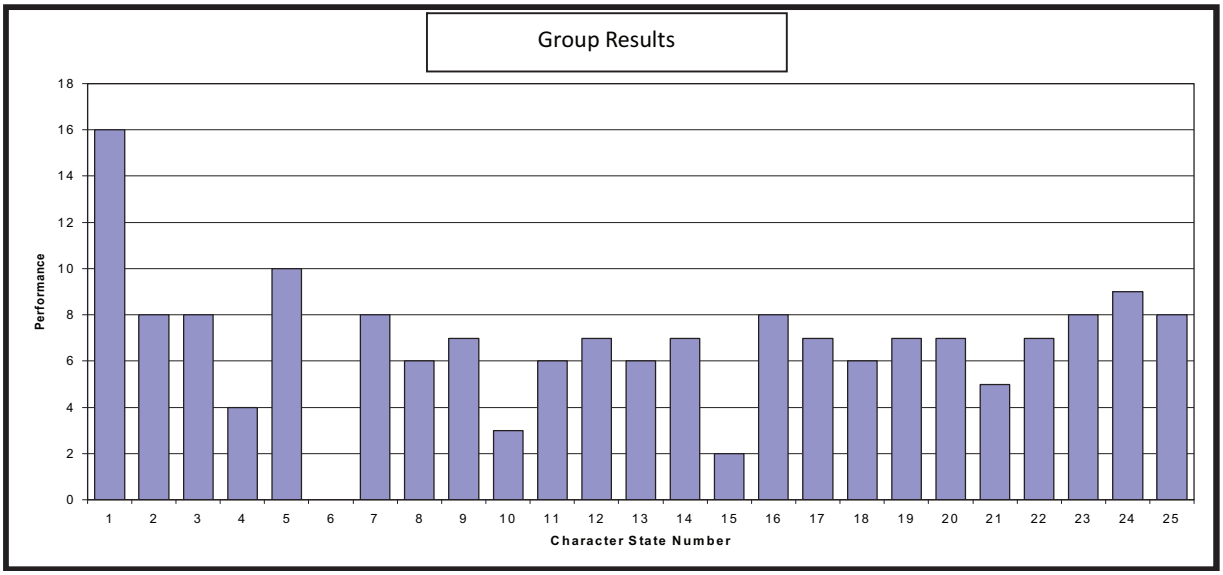
Each bar in the simulations (see figures 1 and 3-6) represents a character-state with the number indicated below. The presentation of results has been simplified using Microsoft Excel®. This is to enhance interpretation with the reader in mind. The height of each bar is an indication of the value to the firm of that particular character-state relative to the other character-states in terms of the performance criteria. The simulations presented here launched the character-states with a starting value of 5 units. Before the results are presented there are two qualifications that need to be highlighted. The first is that the particular simulations presented here are among many possible trajectories dependent on initial conditions. All simulations of the different managers, however, begin with identical initial conditions. In addition, the simulations selected were deemed fairly representative of a series of repeat simulations. The second qualification is that, unlike reality, the simulations depict an evolution of the firm with all character-states starting as

equal (with a value of 5 units). Nonetheless, the results from this procedure do highlight differences (and similarities) between the different decision-makers.

RESULTS AND DISCUSSION

To fully appreciate the effects of diverse decision-making capacities, five simulations are presented. To summarise the first, figure 1 depicts, in simplified form, an evolutionary trajectory of the firm when all the decision-makers' opinions are aggregated together. Twenty out of the twenty-five character-states increased their standing in terms of value at the final stable solution. Nine character-states equalled or exceeded 8 value-units and two, CS1, ISO 9000, and CS5, decentralised error detection and correction, reached double figures. CS21, production process traceability, kept its initial value, whilst CS4, selective preventive maintenance, CS10, line-balancing, and CS15, full resource visibility, declined by 1, 2 and 3 value-units respectively. CS6, outsourced corrective maintenance, failed altogether during the simulation.

Figure 1 - Simulated firm evolution using aggregated data



There are several significant points to discuss here. The first is that the simulations reveal management concerns, both collectively (in terms of team decision-making) and individually, that can then be flagged up for further discussion and exploration, similar to the 'what-if' scenario building of Nilsson and Darley's (2006) work. Taking the collective concerns as an illustration, when the managers' opinions are aggregated, CS6, outsourced corrective maintenance, fails, indicating a consensus that this practice is problematical, perhaps costs incurred are significant or that the relationship with the sub-contractor is poor. The simulation also flags up concerns over CS4, selective preventive maintenance (which may in part be due to the misgivings with CS6, outsourced corrective maintenance) CS10, line-balancing and CS15, full resource visibility, which were low performers relative to other character-states. Overall, the integrity of the organisation was very good, however, signifying that as a decision-making group the managers are more complementary than not.

The second point concerns the nature of the model, the micro-diversity that has been captured and the potential insights that this gives. As can be seen from the research methods, the model draws directly from the opinions and views of managers rather than from logical 'if-then' rules and averaged mathematical representations of agents that characterise agent-based and other self-organisational models, particularly those proposed by Lim and Zhang (2003), Zhou et al (2003), Li et al (2003), and Poundarikapuram and Veeramani (2004). However, the micro-diversity is represented here by the individual managers' opinions, which cannot be fully appreciated in the first simulation (figure 1).

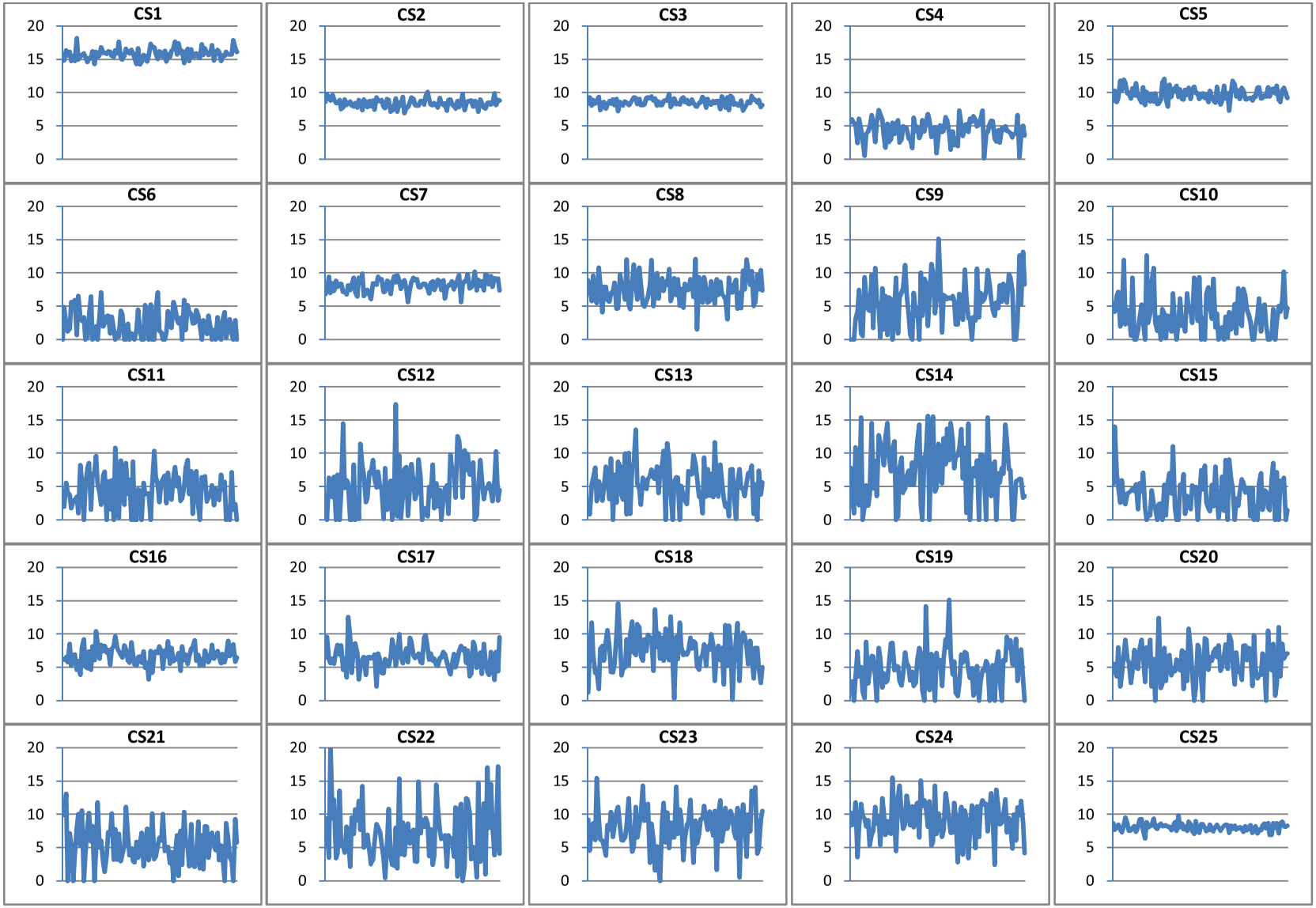
This limitation exists in previous research (see, for example, Baldwin et al., 2005) where opinions of manufacturing managers, operations managers, CEOs and company managers were averaged out. As such, significant information is lost. It would appear that respondents had very diverse views of how technologies and practices interacted with one another. Unfortunately, the methodology prevented the analyses of views of the individual respondents. This was due to the large numbers of characteristics; that is, the survey instrument had to be divided into four parts with one person only giving their opinions on a quarter of the total number of characteristics. This limitation is addressed here in that the opinions of different managers in a firm are considered fully and can be explored individually. The means and standard deviations of the character-state performances resulting from the managers' opinions are presented in table 2.

Table 2 – Means and standard deviations of the character-state performances

CS	Mean	SD	CS	Mean	SD	CS	Mean	SD
1	16.00	0.82	**10**	3.00	3.46	**18**	7.25	2.63
2	8.50	0.58	**11**	4.50	3.32	**19**	4.75	3.20
3	8.50	0.58	**12**	5.00	3.37	**20**	5.75	2.50
4	4.25	1.50	**13**	4.75	3.40	**21**	4.75	3.40
5	9.75	0.96	**14**	6.75	4.99	**22**	7.25	4.35
6	1.50	2.38	**15**	3.25	3.59	**23**	8.50	3.11
7	8.25	0.96	**16**	6.75	1.50	**24**	9.00	2.83
8	7.25	1.89	**17**	6.75	1.71	**25**	8.00	0.60
9	5.50	3.42						

Figure 2 graphically displays the results from 100 simulations of the performance of individual character-states giving an indication of variability and degree of character state failure throughout the simulations. As can be seen, character-states with the most variability, in descending order are: CS14, ERP; CS22, MRP; CS15, full resource visibility; CS10, line-balancing; CS9, employee multi-skilling; CS13, empowering employees; CS21, production process traceability; CS12, flexible workers; CS11, job rotation; CS19, resource priority control; and, CS23, ERP customer integration. Character states that had high failure rates, in descending order, are: CS6, outsourced corrective maintenance failing in 23% of simulations; CS10, line-balancing (14% failure rate); CS15, full resource visibility (13% failure rate); CS11, job rotation (12% failure rate); and CS12, flexible workers, 14, ERP, and CS19, resource priority control, all failing in 10% of simulations.

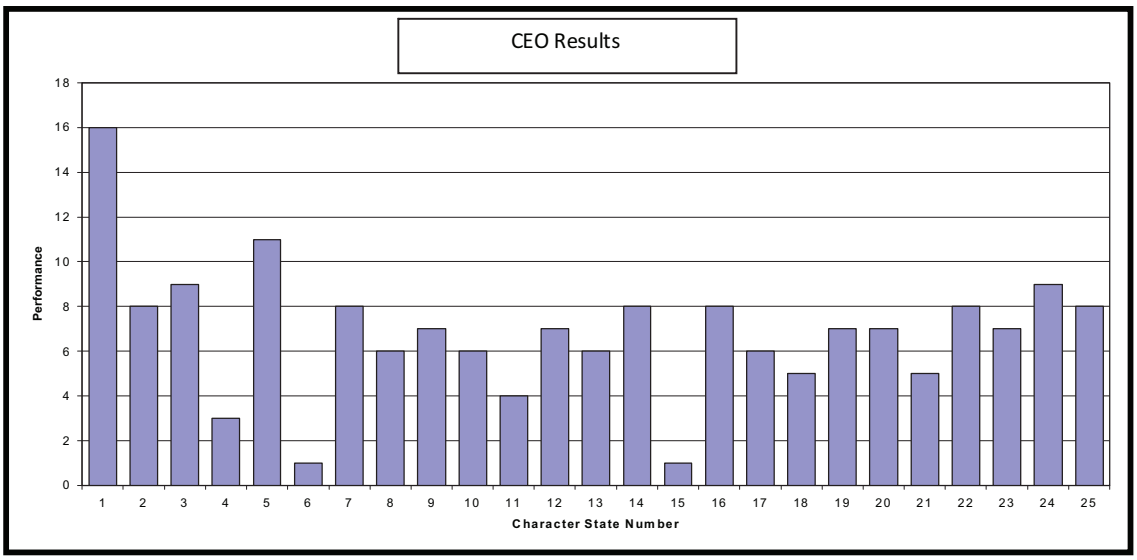
Figure 2 – Variability of character-state performance and degree of failure



An important point to make here is that the degree of failure rate in the simulations is not a sufficient indicator of a problem in actual practice, if, for example, it is accompanied with high variability which is an indicator of management disagreement. However, if a high failure rate in combination with low variability is found then the likelihood of a genuine problem in practice is high. This is most evident with CS6, outsourced corrective maintenance, which has the highest failure rate together with only low-to-moderate variability.

To explore this variability in more detail, the next step in the research procedure was to analyse the opinions of the different decision-makers separately and compare and contrast the results. Figure 3 shows a simulation of the CEO's opinions at the stable solution. During this simulation, nineteen of the twenty-five character-states increased on their initial value with ten character-states equalling or exceeding 8 value-units. CS1, ISO 9000, and CS5, decentralised error detection and correction, again reached double figures. CS18, setup time reduction, and CS21, production process traceability, remained at their original value. As with the first simulation, CS4, selective preventive maintenance, CS6, outsourced corrective maintenance, and CS15, full resource visibility, declined in value but this time were joined by CS11, job rotation, which stabilised at 4 units. No character-state failed during this simulation.

Figure 3 - Simulated firm evolution using CEO's data

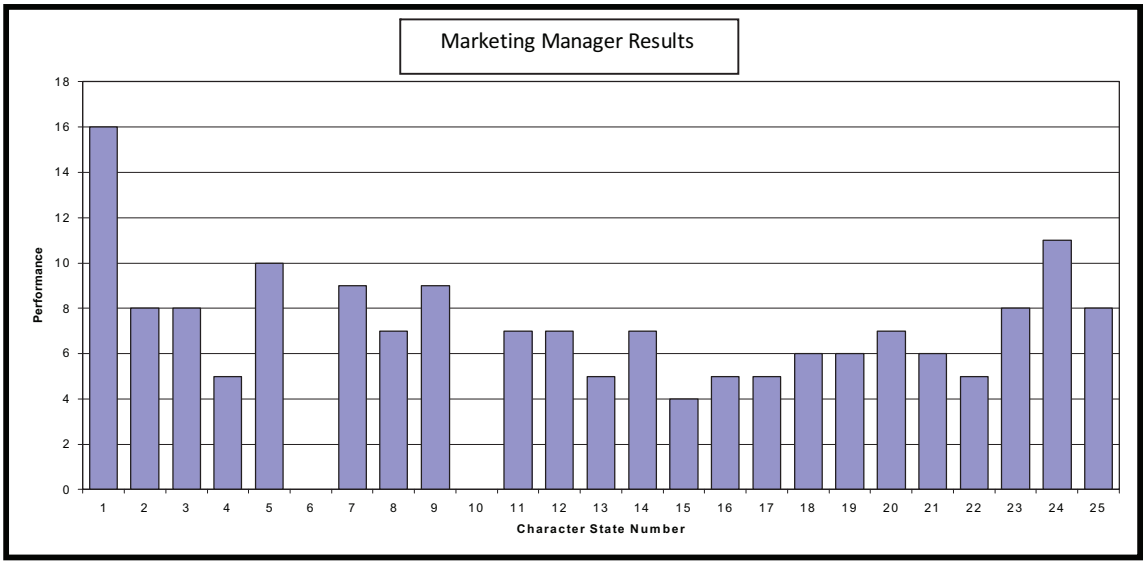


Interestingly, the CEO's simulation largely mirrors the first simulation where all the managers' opinions are aggregated. This raises several intriguing questions. Does the CEO have a more overarching model of the 'mechanics' of the firm reflecting the consensus of the group of managers? Or does the CEO have the ability to project his understanding/influence onto the other managers in their particular fields of functional expertise? This may reflect in some respects, for example, what Jarratt (1999) sees as achieving the right balance between centralised and de-centralised systems in the management of diversity. An important observation is that the CEO's results did not have any character-state failures. This gives a strong impression that the CEO does indeed have at least a healthy view of the organisation and, in contrast to the other managers, sees how all the character-states work and fit together. However, the CEO did appear to have concerns over CS4, selective preventive maintenance,

CS6, outsourced corrective maintenance, CS11, job rotation and CS15 full resource visibility, which, apart from CS11, job rotation, reflects the simulation of the aggregated opinions.

Figure 4 portrays the Marketing Manager's simulation at the final solution. To summarise, during this simulation, seventeen of the twenty-five character-states increased on their initial value, with nine equalling or exceeding 8 value-units. Three, CS1, ISO 9000, CS5, decentralised error detection and correction, and CS24, supplier co-operation, reached double figures. In this instance, five character-states, i.e. CS4, selective preventive maintenance, CS13, empowering employees, CS16, setup automation, CS17, cells with automated equipment, and CS22, MRP, remained at their original values whilst CS15, full resource visibility, fell by 1 value-unit. Two character-states, i.e. CS6, outsourced corrective maintenance, and CS10, line-balancing, failed altogether.

Figure 4 – Simulated firm evolution using Marketing Manager's data

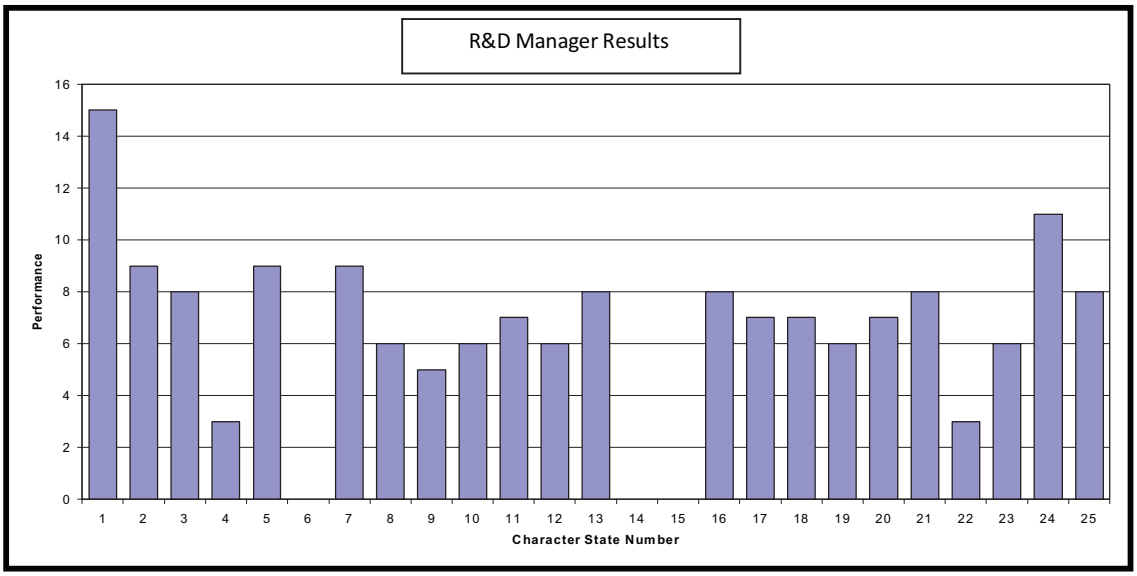


This simulation begins to demonstrate the significant role that individual differences or diversity has in the management decision-making process and add support to the arguments of Allen et al (2006), Poundarikapuram and Veeramani (2004), and O'Leary-Kelly and Flores (2002). In the Marketing Manager's simulation there are several differences that need to be highlighted. The first is that only seventeen of the twenty-five character-states improved on their starting value. This is in contrast to the first two simulations where there were improvements for twenty of the aggregated scores and nineteen of the CEO's scores. However, seven of the nine character-states that surpassed 8 value-units agreed with the CEO. The main difference, particularly in terms of the CEO's results, was that two character-states, CS6, outsourced corrective maintenance, and CS10, line-balancing, failed altogether. Although the performance of the former character-state reflects the aggregated results and to a degree the CEO's simulation, the latter is opposed to the opinion of the CEO. The Marketing Manager's negative impression of line-balancing may be a symptom, for example, of functional barriers (Malhotra and Sharma, 2002; Rhee and Mehra, 2006) and is another area for further management analysis.

The R&D Manager's simulation at closing is shown in figure 5. To sum up, nineteen out of twenty-five character-states increased on their starting value. This time, ten character-states

reached values of 8 units or more with two, CS1, ISO 9000, and CS24, supplier co-operation, exceeding double figures. Only one, CS9, employee multi-skilling, remained constant. CS4, selective preventive maintenance, and CS22, MRP, declined in value with both losing approximately 2 value-units. Furthermore, CS6, outsourced corrective maintenance, CS14, ERP, and CS15, full resource visibility, all failed to make an impact during the simulation and disappeared.

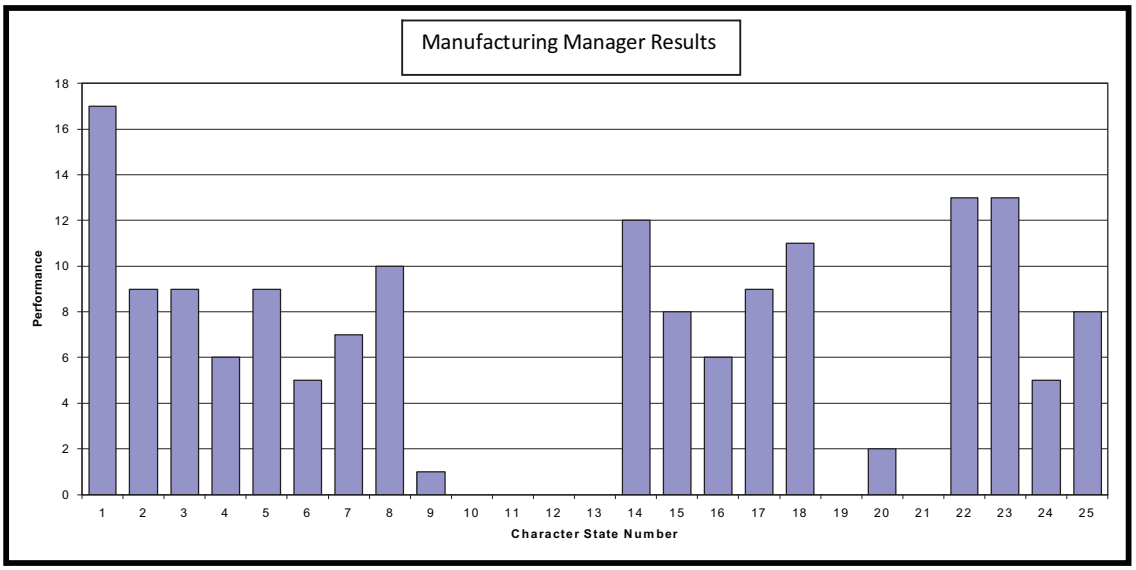
Figure 5 – Simulated firm evolution using R&D Manager's data



The R&D Manager's results largely agreed with the latter two managers but with obvious exceptions. Agreement surrounded CS1, ISO 9000, CS5, decentralised error detection and correction, CS7, 5S's programme, CS24, supplier co-operation, and CS25, R&D investment, which all had good performances with end values of over 8 units (that is, eight out of ten character-states in agreement with the CEO). Furthermore, both CS6, outsourced corrective maintenance and CS15, full resource visibility, failed for the R&D Manager – the CEO and Marketing Manager's simulations also resulted in low scores for the latter with 1 and 4 value-units, respectively. The point of divergence concerns both CS14, ERP, which had no place in the final solution, and, CS22, MRP, which had a very weak performance relative to most other character-states. In this instance, a plausible explanation is the fact that the firm has both ERP and MRP systems running simultaneously, where the former should be in replacement of the latter. However, no other managers' simulation flagged this and represents another area for investigation.

The final simulation at conclusion, based on the Manufacturing Manager's opinion scores, is presented in figure 6. During this simulation fifteen of the twenty-five character-states improved on their initial value of 5. Twelve of these equalled or exceeded 8 value-units with six reaching double figures. Two, CS6, outsourced corrective maintenance, and CS24, supplier co-operation, remained at their original values. Another two, CS9, employee multi-skilling, and CS20, 24 hour production, declined in value, stabilising at approximately 1 and 2 units of value, respectively. The remaining six character-states failed altogether during the simulation. These were CS10, line-balancing, CS11, job rotation, CS12, flexible workers, CS13, empowering employees, CS19, resource priority control, and CS21, production process traceability.

Figure 6 – Simulated firm evolution using Manufacturing Manager's data



The Manufacturing Manager's simulation took on the most extreme final configuration and was in stark contrast to the rest of the decision-makers' simulations and is the best example of the significant role and impact of diversity among decision-makers alluded to by Nilsson and Darley (2006), Allen et al, (2006) and Jarratt (1999). The most obvious difference was that six character-states failed with an additional two barely surviving, finishing with less than 2 value-units. Of the eight character-states that failed or underperformed, six surrounded policies concerning employees (i.e. employee multi-skilling, line-balancing, job rotation, flexible workers, empowerment, and 24 hour working pattern). This pattern indicates that the Manufacturing Manager has issues with the way the workforce is utilised. Suggested reasons could be that the employee policies are not working as intended or that the manager has different preferences. With only fifteen character-states gaining on the original values, it was, however, interesting that twelve of these reached or exceeded 8 value-units, which was the most out of all simulations. With both the failures and high scoring character-states, this simulation represents the most extreme potential evolutionary trajectory of the firm out of the five presented here. This simulation when compared to the other simulations also lends significant support for a long standing call voiced by O'Leary-Kelly and Flores' (2002) and Malhotra and Sharma (2002) for more integration and understanding between functional areas and particularly between operations and other functional areas.

On a general reflection, a consensus is evident among all managers surrounding the importance of a good proportion of character-states including (indicated by 8 value-units or above in the majority of simulations): CS1, ISO 9000, CS2, materials purchasing standards, CS3, 100% inspection, CS5, decentralised error detection and correction, CS7, 5Ss programme, CS16, setup automation, CS23, ERP customer integration, CS24, supplier co-operation, and CS25, R&D investment. The practical usefulness perhaps lies more in the exploration of the more problematical areas (Nilsson and Darley, 2006). Character-states in need of review and discussion (signified by multiple failures) include CS6, outsourced corrective maintenance (3 failures) and CS10, line-balancing (2 failures). The results suggest that the policies concerning employees may also need revisiting, as a good proportion faired

relatively poorly rarely breaching 8 value-units. In terms of methodology, the findings also strengthen the consistency/reliability of the data collection procedure adapted from previous work (Allen et al., 2005; 2006; 2007; Baldwin et al., 2005).

CLOSING REMARKS

This research aimed to provide insights into the potential evolutionary effects of the diversity in management decision-making and attempted to add not only to the theoretical development of complex systems thinking but perhaps more so to the application of computational models and simulations which is still arguably lacking in particular area of Operations and Production Management (Macbeth, 2002; McCarthy, 2004; Nilsson and Darley, 2006). To build on this, further work and clarification is required into the potential underlying reasons and consequences for the successes and failures of particular technologies, practices and policies. More case studies are also required firstly, to strengthen the reliability and validity of the methods employed and secondly, to encompass more management decision-making scenarios.

In terms of practical value, evolutionary complex systems models and simulations, along with other similar tools such as those advocated by Nilsson and Darley (2006) and Meade et al (2006), offer a more realistic decision-support tool for management with which to explore the strengths, weaknesses and consequences of different decision-making capacities within the firm. In this research, for example, out of the four decision-makers, the CEO appeared to have the most balanced view of the organisation as all character-states successfully survived. Both the Marketing and R&D Managers had similar simulation outcomes to the CEO but with two to three character-state failures. The Manufacturing Manager simulation took the most extreme evolutionary trajectory and highlighted the potentially disastrous effects of diversity in decision-making. In future, this approach may also be used to explore underlying opinions, beliefs and attitudes along with their potential consequences on the evolutionary trajectory of a firm when introducing an entirely new manufacturing technology, practice or policy.

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AN EXPLORATORY RESEARCH ON SUPPLY CHAIN PERFORMANCE MEASUREMENT FRAMEWORK FOR THE THAI JEWELRY INDUSTRY

Achara Satayapaisal, Shinawatra University (SIU), Bangkok,Thailand
Chuvej Chansa-ngavej*, Shinawatra University (SIU), Bangkok, Thailand
chuvej@shinawatra.ac.th

ABSTRACT

Supply chain management (SCM) has become a strategic tool that strengthens the industries to stay competitive. To have the right information for making the right decision to manage the supply chain in a competitive environment, the performance metrics are necessary. The purpose of the research is to gain insight about the performance measurement system and the metrics used for evaluating supply chains performance, including their relative strengths and weaknesses so that precautions could be made while developing the performance measurement system. Additionally, a number of models and frameworks found in the research process on performance measurement were also examined. The outcomes of the research will be used as the input for proposing the appropriate model for evaluating supply chain performance of the Thai jewelry industry.

Keywords: Supply chain performance, Performance measurement system, Metrics

INTRODUCTION

Nowadays supply chain management (SCM) has become a strategic tool that strengthens the industries to stay competitive. It is essential for the organizations to have the suitable performance measures or "metrics" for effectively evaluating and reflecting the performance of supply chains (Hausman, 2005; Neely, 2007). This is so that they can have the right information to make the right decisions and the resources available can be efficiently allocated for managing the organization and improving the competitiveness (Gunasekaran & Kobu, 2007; Kaplan & Norton, 2005). The Thai gems and jewelry industry is chosen for establishing the model for evaluating its supply chain performance because of its importance to the Thai economy. It has been continually ranked one of the top ten of the Thai export products for several years. Having low labor costs as a competitive advantage factor is no longer sufficient for surviving under this highly competitive economy. Therefore, the effective supply chain management has become a strategy that strengthens the industry to stay competitive. There are several studies that tried to outline how to measure the efficiency of the supply chain, such as Gunasekaran, et al. (2001); Van Hoek (2001). However, an effective assessment tool, which could be different from industry to industry, is required. Also, the business environment has changed over the years. Therefore, the existing performance measures and metrics are re-assessed whether they can be used or a new set of measures is needed in addition to some of the existing ones.

IMPORTANCE OF PERFORMANCE MEASUREMENT SYSTEMS

A performance measurement system is important to manage a business as it provides the information necessary for decision making so that timely action can be taken (Gunasekaran & Kobu, 2007). As in Kaplan and Norton (1996b)'s "No measures, no improvement", thus, it is essential to measure the right things at the right time so that the right action can be taken. Gunasekaran and Kobu (2007) opined that performance measures and metrics were also embedded with politics, emotions and several other behavioral issues, good performance measures and metrics would help communication between people to be more open and transparent which led to a co-operative supported work and therefore improved organizational performance. In addition, the purposes of measuring performance found in the literature are as follows:

- to identify success (Parker, 2000; Gunasekaran & Kobu, 2007)
- to determine if the performance met strategic goals and objectives (Maskell, 1991 as cited in Beamon, 1999)
- to provide information for aligning business activities with organizational goals and objectives (Jensen, 2000),
- to provide information needed in order to set goals based on current performance (Jensen, 2000),
- to communicate to staffs about the performance aspects essential for organization success, current performance, and how their individual efforts contributed to the organizational success (Jensen, 2000; Maskell, 1991 as cited in Beamon, 1999),
- to identify whether customer requirements were met through the measurement (Parker, 2000; Gunasekaran & Kobu, 2007),
- to help the organizations to understand their processes by confirming what they know or revealing what they do not know (Kaplan & Norton, 2005; Parker, 2000; Gunasekaran & Kobu, 2007)
- to identify where existing of problems such as bottleneck, waste, etc.; and risks are and where improvements are necessary (Jensen, 2000; Parker, 2000; Gunasekaran & Kobu, 2007),
- to provide information required for strategic, capital investment, and other decisions so that decisions were based on facts, not on supposition, emotion, faith, or intuition (Jensen, 2000; Parker, 2000; Gunasekaran & Kobu, 2007),
- to show if improvements planned, actually happened (Parker, 2000; Gunasekaran & Kobu, 2007),
- to provide trend information for improvement by analyzing historical documentation of performance (Jensen, 2000; Kaplan & Norton, 2005)

PITFALLS OF PERFORMANCE MEASUREMENT SYSTEMS

The intention behind the establishment of performance measurement systems is to focus organizational attention on particular outputs and outcomes, and to align the behavior of individuals with overall organizational goals and the expectations of stakeholders. Inappropriate performance measurement systems such as a single metric or narrowly specified sets of metrics will encourage local optimization rather than global optimization, "bad" metrics will mislead people in the organization and can sometimes decrease the performance of a whole system; etc. (Hausman, 2005; Neely, 2007). Examples of inappropriate performance measurement systems are provided as follows:

- A wholesaler of electrical components which consisted of several separate branches, encouraged optimization at the branch level by measuring each branch profitability. Each branch manager was measured and rewarded based on the profitability of their branch. While all of the branches were part of the same organization but they competed each others to meet their goals. One of their customers knew that they could request a quote for 100 light bulbs from one branch, and then asked a second branch to see if they were willing to undercut the first branch. If the second branch offered a lower quote, this customer would call the first branch again to tell that they would lose the order unless they were willing to offer the new best price. This revealed that only the branch maximized their profit with a sale but the whole organization lost. (Neely, 2007)
- A traditional metrics of surface mount production lines was "cost per insertion". To minimize cost per insertion, the large production run of the same batch that minimized number of changeover and setup was created. The results of this longer run would be a lowered cost per insertion, whereas an increased inventory of finished goods occurred. Although the cost-related performance resulted positively, the overall performance of the surface mount factories could decrease. (Hausman, 2005)
- Many companies paid their attention on minimizing freight costs, which are tangible, while ignoring the inventory cost which is often measured indirectly or not even is measured. Hence, many companies used strict transportation policies like always shipping by full-truck loads or full container loads; or always shipping by sea freight. This results in the minimization of the transportation cost but the overall supply chain performance could suffer from the negative impact on inventory and customer service. (Hausman, 2005)

PERFORMANCE MEASUREMENT MODELS AND FRAMEWORKS

Several performance measurement frameworks have been proposed that support the processes to design and implement performance measurement systems in supply chain and in an individual organization. The objectives of such frameworks are to help organizations to identify and define an appropriate set of performance measures and metrics that reflects their objectives and assesses their performance. The frameworks can be separated into two groups: supply chain performance measurement and an individual organization performance measurement. The frameworks included in each group are as follows:

- Supply chain performance measurement: Supply Chain Operations Reference Model (SCOR) (Supply Chain Council, 2008); Beamon's Model (Beamon, 1999); Chan and Qi's Model (Chan & Qi, 2003a, b); and Benchmarking.
- An individual performance measurement: Balanced Scorecard (BSC) (Kaplan & Norton, 1996b); and Performance Prism (Adams & Neely, 2002).

Supply Chain Operations Reference Model (SCOR model)

In 1996 supply chain consulting firm Pittiglio Rabin Todd and McGrath (PRTM) and AMR Research (www.amrresearch.com) introduced the Supply Chain Operations Reference Model (SCOR) and founded the Supply Chain Council (SCC), a user-based organization that owns the SCOR intellectual property. (Husby, 2007).
The Supply Chain Operations Reference model (SCOR) has been developed as the cross-industry standard diagnostic tool for supply chain management. SCOR enables users to

address, improve and communicate supply chain management practices within and between all interested parties. SCOR provides a unique framework that links business process, metrics, best practices and technology features into a unified structure to support communication among supply chain partners; providing users with a framework for understanding where they need to make improvement which encourage improving the effectiveness of supply chain management and related supply chain improvement activities. Francis (2007), the chief technology officer for the SCC, pointed out that successfully using the SCOR model would gain six major benefits:

- SCOR helped to manage the business by providing detailed visibility into how work actually got done;
- SCOR helped companies compete more effectively through their system of metrics that were objectively linked to business processes;
- SCOR's end-to-end supply chain focus also points companies toward real process improvements, as opposed to just moving bottlenecks from one place to another;
- The use of SCOR metrics and attributes usually improved cost and cycle time and reliability;
- SCOR roadmaps helped streamline and accelerate business change by mapping out the process improvement cycle; and
- SCOR promotes team building.

The SCOR model builds on the concepts of business process reengineering, benchmarking, and process measurement by integrating their techniques into a cross-functional framework. The SCOR model itself contains several sections and is organized around the five distinct management processes of Plan, Source, Make, Deliver, and Return as shown in Figure 1. (Supply Chain Council [SCC], 2008)

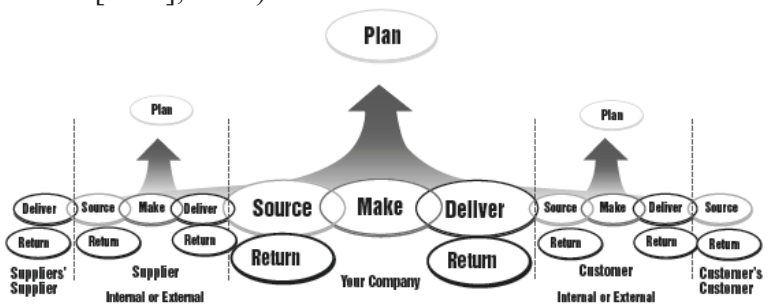

Figure 1 The Five Distinct Management Processes of SCOR model
Source: SCC (2008)

The SCOR model can span all customer interactions from order entry through paid invoice; all product (physical material and service) transactions from suppliers' suppliers to customers' customers, including equipment, suppliers, spare parts, bulk product, software, etc.; and all market interactions from the understanding of aggregate demand to the fulfillment of each order. However, it does not attempt to describe every business process or activities including sales and marketing, research and technology development, product development, and some elements of post-delivery customer support. Moreover, the SCOR model assumes but does not address the following activities: training, quality, information technology (IT), and administration (of non-SCM). As in Figure 2, the SCOR model is divided into a four-level hierarchical pyramid structure. However, the SCC has focused on three levels of processes (Top level, Configuration level, and Process Element level) and the levels progressively increase in process detail and specificity (SCC, 2008).

The SCOR model decomposes the five level 1 processes into level 2, allowing the user to define the configuration of their supply chain, whether it is make-to-stock, make-to-order, or engineer-to-order. Defining the configuration is important to insure the relevance of benchmark data. Level 3 defines processes (how work is done), which include metrics, a series of practices and enabling technology tools. Level 1 and level 2 performance metrics link directly to level 3 metrics facilitating the identification of the level 3 processes which explain level 1 performance. (Husby, 2007; SCC, 2008)

The SCOR model does not attempt to prescribe how a particular company should conduct its business or change its systems and information flows. Therefore, level 4 in Figure 2 deals with functional and organizational implementation by defining specific tasks of level 3 processes. It is the level at which supply chain management practices are implemented. Thus, activities at this level are specific to each business. SCOR excludes level 4 from the model because implementation is unique to each business, thus making standardization is difficult. (Husby, 2007; SCC, 2008; Siegl, 2008).

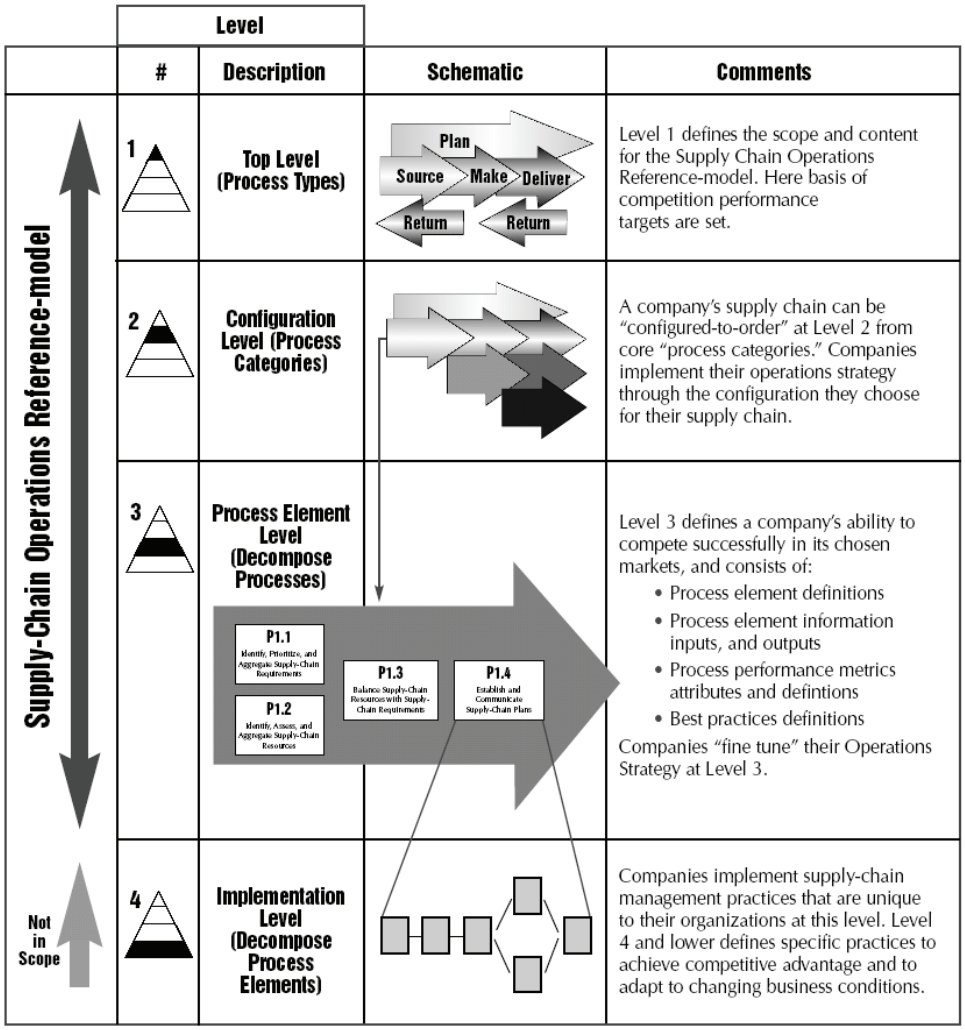

Figure 2 SCOR Model Contains Three Level of Process Details (Level 1 to 3)
Source: SCC (2008)

According to SCC (2008), The SCOR model level 1 strategic metrics have been established, as in Table 1. The SCOR metrics are used in conjunction with performance attributes: reliability, responsiveness, agility, cost, and assets. The performance attributes are

characteristics of the supply chain that permit it to be analyzed and evaluated against other supply chains with competing strategies. An implementing organization can use these metrics for measuring how successful they are in achieving their desired positioning within the competitive market space. Level 1 metrics are created from lower level calculations and are primary and high level measures that may associate with multiple SCOR processes. Level 2 and level 3 metrics are lower level calculation and associated with a narrower subset of processes. (SCC, 2008)

Table 1 SCOR Level 1 Strategic Metrics

Level 1 Metrics	Performance Attributes				
	Customer-Facing			Internal-Facing	
	Reliability	Responsiveness	Agility	Cost	Assets
Perfect Order Fulfillment	✓				
Order Fulfillment Cycle Time		✓			
Upside Supply Chain Flexibility			✓		
Upside Supply Chain Adaptability			✓		
Downside Supply Chain Adaptability			✓		
Supply Chain Management Cost				✓	
Cost of Goods Sold				✓	
Cash-to-Cash Cycle Time					✓
Return on Supply Chain Fixed Assets					✓
Return on Working Capital					✓

Source: adapted from SCC (2008)

While the SCOR model is concerned with processes, not functions, it provides a common language and reference for organizations, enabling them to communicate clearly and manage, measure, and evaluate process elements to ensure customer satisfaction. However, similar to most tools, the SCOR model is only a guideline. The success of any tool or process depends on organizations having a clear understanding of the capabilities and limits of that particular tool or process. It also requires organizations implementing and using the tool properly to maximize its potential. Employing the SCOR model and business best practices can be powerful methods to improve the supply chain. (Siegl, 2008)

Beamon's Model

Beamon (1999) indicated the use of resources, the desired output and flexibility (how well the system reacts to uncertainty) had been identified as vital components to supply chain success. Thus, a supply chain measurement system had to place emphasis on three separate types of performance measures: resource measures (R), output measures (O), and flexibility measures (F). Each of these three types of performance measures had different goals and purposes, the details can be illustrated in Table 2.

Table 2 Goal and Purpose of Each Types of Performance Measure

Type of Performance Measure	Goal	Purpose
Resources (R)	High level of efficiency	Efficient resource management is critical to profitability.
Output (O)	High level of customer service	Without acceptable output, customers will turn to other supply chains.
Flexibility (F)	Ability to respond to a changing environment	In an uncertain environment, supply chains must be able to respond to change.

Source: adapted from Beamon (1999)

Each of the three types of performance measures had as its important characteristics the measure of each type affects the others. Beamon (1999) has developed the model of the inter-relationship among Resource (R), output (O), and Flexibility (F), as shown in Figure 3.

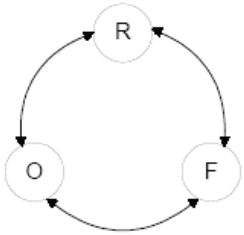

Figure 3 The Inter-Relationship among Resource (R), Output, and Flexibility (F)
Source: Beamon (1999)

The model proposed by Beamon (1999) posited that a supply chain performance measurement system must contain at least one individual measure from each of the three types of performance measures: *Resources* (R), *Output* (O), or *Flexibility* (F). The individual measures chosen from each type must match with the organization's strategic goals. Each type of performance measure is explained in the following itemized list:

Resources (R)

Resource measures include: inventory levels, personnel requirements, equipment utilization, energy usage, and cost. *Resources* are generally measured in terms of the minimum quantities or a composite "efficiency" measure.

"Efficiency" measures the utilization of the *resources* in the system that is used to meet the system's objectives. Not enough *resources* can negatively affect the *output* and the *flexibility* of the system, while too many *resources* may artificially increase the system's requirements.

One general goal of supply chain management is to minimize *resource* uses. While reducing *resources* will specify a minimum of required *output*, but the effect of reducing *resources* on the *flexibility* of the supply chain is not often considered. *Resources* are directly related to the system's *output* and *flexibility* performance.

The example of supply chain *resource* performance measures are listed in Table 3

Table 3 The Supply Chain *Resource* Performance Measures

Resources **Performance Measures**	**Definition**
Total Cost	Total cost of resources used.
Distribution Costs	Total cost of distribution, including transportation and handling costs.
Manufacturing Cost	Total cost of manufacturing, including labor, maintenance, and rework costs.
Inventory Cost	Costs associated with held inventory
Return on Investment (ROI)	The return on investment is generally given by the ratio of net profit to total assets.

Source: adapted from Beamon (1999)

Output (O)

Output measures include: customer responsiveness, quality, and the quantity of final product produced. Many output performance measures are easily to be quantitative, such as number of items produced; time required producing a particular item or set of items; number of on-time deliveries (orders), etc. However, there are also many *output* performance measures that are much more difficult to quantify, such as customer satisfaction; product quality. A level of *output* is often specified as minimum requirements, whereas the relationship between the costs required to achieve different *output* levels is not generally considered. For instance, what is the added value or costs if the product is delivered early or late? Normally, *output* measures are based on short, finite time horizons, and address issues such as how many did I produce today? Thus, *resources* affect the *output* of a supply chain, and the *output* of the supply chain system is important in determining the *flexibility* of the system. Output performance measures must correspond to both the organization's strategic goals, and the customers' goals and values. For example, if the customers' value preferred delivery reliability than fast delivery, therefore, short lead times were not as important as to have the product delivered on time. Although lead times may be extremely important to the manufacturer, on-time delivery was more important to the customer. In this case, both of these output performance measures should be utilized. The example of supply chain *output* performance measures are listed in Table 4.

Table 4 The Supply Chain *Output* Performance Measures

Output **Performance Measures**	**Definition**
Sales	Total revenue
Profit	Total revenue less expenses
Fill Rate	Proportion of orders filled immediately
On-Time Delivery	Measures item, order, or product delivery performance
Back Order/Stockout	Measures item, order, or product availability performance
Customer Response Time	Amount of time between an order and its corresponding delivery
Manufacturing Lead Time	Total amount of time required to produce a particular item or batch
Shipping Errors	Number of incorrect shipments made
Customer Complaints	Number of customer complains registered

Source: adapted from Beamon (1999)

Flexibility

Some advantages of flexible supply chain systems are:

- Reductions in the number of backorders, lost sales, or late orders;
- Increased customer satisfaction;
- Ability to respond to and adapt to demand variations (such as seasonality); periods of poor manufacturing performance (such as machine breakdowns); periods of poor supplier performance; periods of poor delivery performance; new products; new markets; or new competitors.

Many supply chain performance measures exist for *resources* and *output*, but the number of *flexibility* measures actually applied to supply chains is few. *Flexibility* can measure a

system's ability to adapt to volume and schedule fluctuations from suppliers, manufacturers, and customers. Actually, *flexibility* is vital to the success of the supply chain, since the supply chain exists in an uncertain environment. A reduction in system *resources* may negatively affect the supply chain's *flexibility*. For instance, a supply chain may be currently utilizing its *resources* efficiently, and producing the desired *output*, however, the supply chain will be affected and needed to adjust or changes in product demand, manufacturing unreliability, the introduction of new products, or supplier shortages. Thus, *flexibility* is an important consideration in supply chain performance. Slack (1991) (as cited in Beamon, 1999) defines system *flexibility* as the flexibility of the entire operation. Four types of system *flexibility* are further identified, as shown in Table 5.

Table 5 Four Types of System *Flexibility*

Flexibility **Type**	**Definition**	**Flexibility Performance Measures**
Volume Flexibility	The ability to change the output level of products produced.	- The range of volumes in which the organization can run profitably. - For manufacturing systems, generally considered the costs associated with volume changes. - For a supply chain volume flexibility measure, generally interested in how much of the demand can be met considering only the range of volumes that are profitable.
Delivery Flexibility	- The ability to change planned delivery dates. - The ability to move planned delivery dates forward which allows the supply chain to adapt to rush orders and special orders.	- Percentage of slack time by which the delivery time can be reduced.
Mix Flexibility (Process and job flexibility)	The ability to change the variety of products produced.	- Range of different product types that may be produced during a particular time period - The number of different products that can be produced within a given time period - Response time between product mix changes. - The time required to produce a new product mix.
New Product Flexibility	- The ability to introduce and produce new products (this includes the modification of existing products). - The ease with which new products are introduced to the system.	- The time required to add new products to existing production operations. (*Time-based new product flexibility*) - The cost required to add new products to existing production operations. (*Cost-based new product flexibility*)

Source: adapted from Beamon (1999)

Each type may not be appropriate for every supply chain. Examining historical data for the system can indicate which flexibility measure types are appropriate for the system of interest. Table 6 identifies supply chain characteristics and their corresponding appropriate flexibility types. However, the volume flexibility is commonly desirable.

Table 6 Supply Chain System Characteristics and Associated Flexibility Types

Flexibility Type	**Supply Chain System Characteristics**
Volume Flexibility	Variable demand.
Delivery Flexibility	Delivery dates change regularly and costs are associated with not meeting new delivery dates.
Mix Flexibility	Stationary demand for multiple product types.
New Product Flexibility	Products with short life cycles.

Source: Beamon (1999)

Chan and Qi's Model

Chan and Qi's innovative performance measurement system (PMS) for supply chains (call "Chan and Qi's model" in this study) was developed in 2003 by Dr. Felix T. S. Chan and H. J. Qi. The model can quantify the relative importance of both supply chain processes and measures with relative to supply chain strategies. This technique enables managers to make connections between strategies and measurement, also to concentrate on key processes and measures that have a significant impact on the overall performance of a supply chain.

Framework of performance measures.

Chan and Qi's model was developed through the concept of performance of activity (POA), an approach to identifying and employing performance measures. The POA concept is based on a supply chain process-based model, by which the supply chain is viewed as a set of integrated processes and structures. A process is a structured set of activities that perform specific functions and produce specific output. For supply chain, the six core processes and structures that are linked comprised of suppliers, inbound logistics, core manufacturer, outbound logistics, marketing and sales, and end customers, as depicted in Figure 4.

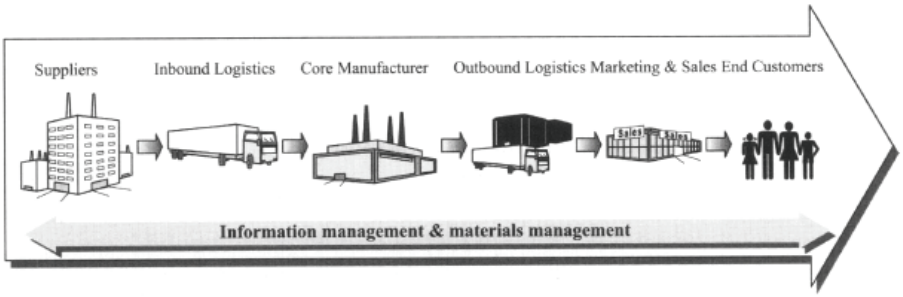

Figure 4 The Six Core Processes and Structures of Supply Chain
Source: Chan and Qi (2003b); Chan, F. T. S, Qi, Chan, H. K., Lau and Ip (2003)

These core processes are then decomposed into sub-processes or further into activities to identify their detailed performance measures. For instance, the inbound logistics can decompose into sub-processes as supply base management, transportation, receiving and inspection, handling, etc. All of these core processes and sub-processes built into a hierarchy of a supply chain model which is a framework of this performance measurement system. The aggregated results of the POAs and sub-processes could portray the performance of their corresponding process. Thus, the measurement of the higher process performance is converted into the activities and lower processes performance. In order to assist in identifying and selecting measures for processes or activities, Chan and Qi (2003b) suggested a board of performance metrics, call metric board, which consists of the holistic dimensions of activity performances, therefore, it build the comprehensive viewing for the concept of POA. The metrics board functions as the referential categories of performance measures. Chan and Qi (2003b) suggested the following performance categories: cost, time, capacity, capability (including effectiveness, reliability, availability, and flexibility), productivity, utilization; and outcome. Therefore, managers should be able to identify and to select performance measures systematically by referring to the balanced dimensions of the metrics board.
After corresponding measures are identified, processes and measures will be grouped into the processes and performance measures hierarchy (PPMH) – the hierarchical framework

composed of supply chain core processes, sub-processes, and performance measures linked to activities. The PPMH is shown in Figure 5.

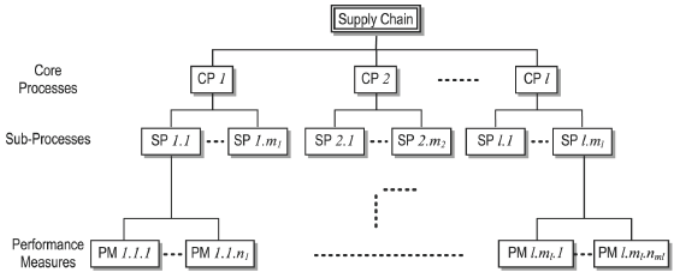

Figure 5 General Structure of the Processes and Performance Measures Hierarchy (PPMH)
Source: Chan and Qi (2003a); Chan et al. (2003)

Measurement algorithm.

Chan and Qi (2003a); Chan et al. (2003) proposed an innovative measurement method that converts performance data from various measures into a meaningful composite index for a supply chain. The methodology developed is based on the fuzzy set theory to address the imprecision in human judgments. A geometric scale of triangular fuzzy numbers (Boender et al., 1989 as cited in Chan & Qi, 2003a) is employed to quantify the comparison ratios of performance measures. The performance data are transformed into fuzzy measurement results by two subsequent mappings. First, the performance data are converted into the performance scores that ranging from 0 to 10. Second, the performance score is translated into a fuzzy performance grade set. The weighted average method is used to aggregate the fuzzy measurement results and to de-fuzzy the fuzzy performance grades into an exact number ranging from 0 to 10, called the performance index (PI). The PI indicates the synthetic assessment of the holistic performances of the supply chain that reveals how a business process performs with respect to the planned goals and histories. This simple number can be used for benchmark the performance in the supply chain systems.

Benchmarking

Benchmarking is a means to determine how well a business unit or organization is performing compared with similar units in the organization or externally. Benchmarking is so useful; it quantifies the performances of similar organizations; established standards and objectives. It provides the use of performance measures in broader perspectives by comparing measure results with best practices which give a good indication and knowledge for improvement. Benchmarking can serve as a process of identifying improvement opportunities (Beamon, 1999; Blanchard, 2007; Parker, 2000; Siegl, 2008). It is used to identify how the industry defines best-in-class, and then to perform a gap analysis. After determine the difference (i.e. gap) compared with best-in-class, and then the necessary steps to improve performance can be taken (Blanchard, 2007; Kaplan & Norton, 2005). In addition to analyze performance measures based on their effectiveness, benchmarking is another important method for performance measure evaluation (Beamon, 1999). Blanchard (2007) mentioned when overall supply chain performance was being measured, companies typically focused on benchmarking metrics, such as those established in the SCOR model.

Balanced Scorecard

The Balanced Scorecard (BSC) was developed in the early 1990's by Dr. Robert Kaplan and Dr. David Norton. The BSC describes and explains what has to be measured in order to assess the strategies' effectiveness. It offers an alternative to traditional financial performance indicators and is useful to predict the future performance. (Parker, 2000) The BSC is not only a measurement system but also a management system that enables organizations to clarify their vision and strategy, as in Figure 6; and translate them into action. The BSC lets executives see whether they have improved in one area which is the expense of another and will protect companies from posting sub-optimal performance. (Kaplan & Norton, 2005)

Figure 6 The Balanced Scorecard
Source: Kaplan and Norton (1996a)

Kaplan and Norton (2005) noted that organizational executives understood that traditional financial accounting measures like return on investment and earnings per share could give misleading signals for continuous improvement and innovation. Besides, the senior executives did not rely on one set of measures, they realized that no single measure could provide a clear performance target or focus attention on the critical areas of the business. Managers wanted a balanced presentation of both financial and operational measures. The balanced scorecard included financial measures that indicated the results of actions already taken and complemented the financial measures with operational measures on customer satisfaction, internal processes, and the organization's innovation and improvement activities, which were the drivers of future financial performance. Since the complexity of managing an organization requires that managers be able to view performance in several areas at once. The BSC allows managers to look at the business from four important perspectives. (Kaplan & Norton, 2005)

Kaplan and Norton (2005) mentioned that the BSC could minimize information overload by limiting the number of measures used. The authors indicated that companies rarely suffer from having too few measures; on the contrary, they keep adding new measures whenever an employee or a consultant suggested. The BSC helped to force managers to focus on the handful of measures that are most critical, by forcing managers to consider all the important operational measures together, the BSC lets them see whether improvement in one area may have been achieved at the expense of another. The BSC translates a mission and strategy into a set of measures and metrics that comprises of four perspectives which link to performance measures (Kaplan & Norton, 2005). The linkage between four perspectives and performance measures are shown in Table 7 and Figure 7.

Table 7 The Four Perspectives of Balanced Scorecard

Perspectives	Basic Questions of Perspectives to link Performance Measures	Examples of Measures/ Metrics
Financial	To succeed financially, how should we appear to our shareholders?	• cash flow • quarterly sales growth • operating income by division • increased market share by segment • return on equity
Customer	How do we become our targeted customers most valued supplier?	• lead time • quality • performance and service
Internal Business Process	What processes must we excel at, to achieve our financial and customer objectives?	Determine the processes and competencies that are most critical, and specify measures to track them, such as: • cycle time • quality • employee skills • productivity
Learning and Growth, or Innovation and Learning	To achieve our vision, how will we sustain our ability to change and improve?	Monitor the ability to: • launch new products • create more value for customers • improve operating efficiencies

Source: adapted from Kaplan and Norton (1996a); Kaplan and Norton (1996b); Kaplan and Norton (2005); Parker (2000)

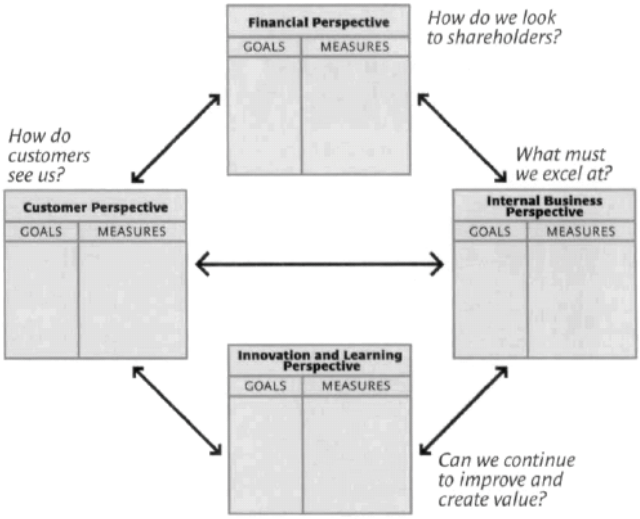

Figure 7 The Balanced Scorecard Linked Performance Measures
Source: Kaplan and Norton (2005)

Financial Perspective: How Do We Look to Shareholders?

Financial performance measures, the traditional needed data, are existent and they indicate whether the company's strategy, implementation, and execution are contributing to bottom-line improvement. Normally, financial goals have to do with profitability, growth, and shareholder value. (Kaplan & Norton, 2005)
Example of financial goal: to survive (measured by cash flow), to succeed (measured by quarterly sales growth and operating income by division), and to prosper (measured by segment and return on equity). A well-designed financial control system can actually enhance an organization's total quality management program.

Customer Perspective: How Do Customers See Us?

Customers are the sources of company revenue. Therefore, poor performance from this perspective is a leading indicator of the company's future decline. The BSC demands the organizations translate their general mission statement on customer service into specific measures which reflect the factors that really matter to customers. Customers' concerns tend to classify into four categories: *Lead time*: the time required for the company to meet its customers' needs. For existing products, lead time can be measured from the time the company receives an order to the time it actually delivers the product or service to the customer. For new products, lead time represents the time to market, or how long it takes to bring a new product from the product definition stage to the start of shipments; *Quality*: measures the defect level of incoming products as perceived and measured by the customer such as on-time delivery (the accuracy of the organization's delivery forecasts); *Performance and service*: measures how the company's products or services contribute to creating value for its customers; and *Cost*. (Kaplan & Norton, 2005)

Internal Business Process Perspective: What Must We Excel At?

Internal business perspective relates to what the company must do internally to meet its customers' expectations. Metrics based on this perspective allow the managers to know how well their businesses are running, and whether their products and services conform to customer requirements. The excellent customer performance derives from processes, decisions, and actions occurring throughout an organization. Companies should attempt to identify and measure their company's core competencies, the critical technologies needed to ensure continued market leadership. Companies should decide what processes and competencies they must excel at and specify measures for each. (Kaplan & Norton, 2005)

Learning and Growth Perspective: Can We Continue to Improve and Create Value?

In global competition circumstance, the targets for organizational successes keep changing and the companies require performing continual improvements on their existing products and processes and having the ability to introduce entirely new products with expanded capabilities. (Kaplan & Norton, 2005)

Performance Prism

A performance prism model was developed in early 2000's by Andy Neely and Chris Adams. The performance prism is a three dimensional model that consists of five facets: the top and bottom facets are Stakeholder Satisfaction and Stakeholder Contribution respectively; and the three side facets are Strategies, Processes and Capabilities. The performance prism model is shown in Figure 8, followed with the fundamental questions and description of each facet is in Table 8. By emphasizing these dimensions of organizational performance, the performance prism seeks to encourage managers to think more broadly about which measures they should introduce. Importantly, the performance prism makes a distinction between what the organization wants of its stakeholders and what the stakeholders want from the organization. So the performance prism starts with stakeholders, not strategies. Since performance measures are designed to help people track whether they are moving in the direction they want to. They help managers establish whether they are going to reach the destination they set out to reach. Strategy, however, is not about destination. Instead, it is about the route

which was chosen to take in order to reach the desired destination. (Neely, Adams & Crowe, 2001; Adams & Neely, 2002; Neely, 2007)

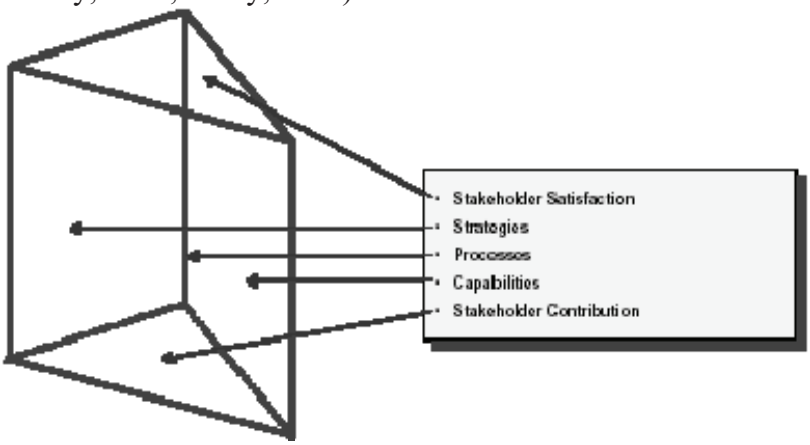

Figure 8 The Five Facets of the Performance Prism
Source: adapted from Adams and Neely (2002)

Table 8 The Five Facet's Explanation of the Performance Prism

Facet #	Facet's Name	Fundamental Question of each Facet	Description
1 (Top)	Stakeholder Satisfaction	Who are the key stakeholders in the organization and what do they want and need?	Broader than the balanced scorecard, besides shareholder and customer, it is also included other stakeholders satisfaction such as employee, supplier, alliance partner, or intermediaries.
2 (Side)	Strategies	What are the required strategies to ensuring the wants and needs of the key stakeholders are satisfied?	Traditional measurement has been argued that measures should be derived from strategy. The performance prism's developers argued that it is wrong because the only reason that an organization has a strategy is to deliver value to some set of stakeholders. Therefore, before start to explore what strategies should be put in place to satisfy stakeholder, the wants and needs of the stakeholder need to be answered first.
3 (Side)	Processes	What are the processes to put in place in order to allow the strategies to be delivered?	These are common processes in the sense of the common generic business processes which are develop new products and services, generate demand, fulfill demand, planned and manage the enterprise. According to each of these processes (normally cross-functional), it should be possible to identify specific measures that allow management to address particular questions associated with each processes and their sub-sets. *Example question*: "Are the organization's fulfill demand processes working efficiently and effectively?", and "If not, how will we know which sub-components of it are the cause of its inefficiency or ineffectiveness?"
4 (Side)	Capabilities	What are the required capabilities to operate the processes?	Capabilities are the combination of people, practices, technology and infrastructure that enable execution of the organization's business processes, and are fundamental of organizations to have ability to compete. Without right capabilities, it is impossible to improve the processes. It is necessary to know the capabilities required to operate the processes before identify measures that allow the organization to assess whether it has the required capabilities in place now, or has plans to implement them, and they are being sufficiently care and protected.

5 (Bottom)	Stakeholder Contribution (opposed to "stakeholder satisfaction")	What are the contributions that are wanted and needed from the stakeholder to maintain and develop the capabilities?	It is the fact that not only organizations have to deliver value to their stakeholders but organizations also enter into a relationship with their stakeholders which need and want the stakeholders contributing to the organization. For example, employees want from a safe, secure workplace, appropriate salary, recognition, give a suggestion and so on. In return, the organization also wants its employees to contribute to the business such as offer ideas and suggestions, to develop expertise, to remain loyal to the business, etc.

Source: adapted from Neely et al. (2001); Adams and Neely (2002); Neely (2007)

After answering the question in facet#1 and 2, the role of measurement is fourfold. First, measures are required so that managers can track whether or not the strategies they have chosen are actually being implemented. Second, measures can be used to communicate these strategies within the organization. Third, measures can be applied to encourage implementation of strategies. Fourth, the measurement data can be analyzed and used to challenge whether the strategies are working as planned (and, if not, why not). Thus, the right measures do not only offer a means of tracking whether strategy is being implemented, but also a means of communicating strategies and encouraging implementation.
Once the strategies have been identified and the right measures established, it is assumed that everything will be fine. However the studies suggest that some of managers fail to implement and deliver their organization's strategies. One of the key reasons for strategic failure is that the organization's processes are not aligned with its strategies. Additionally, even if its processes are aligned, then the capabilities required to operate these processes are not. Hence the next two facets on performance are the processes and capabilities perspectives. (Neely et al. 2001; Adams & Neely, 2002; Neely, 2007)

STRENGTH AND WEAKNESS OF MODELS AND FRAMEWORKS

To build a useful and customized supply chain performance measurement system for the Thai jewelry industry, there are needs to examine the supply chain process carefully and understand the tradeoff between different models, Table 9 provides the analysis of strength and weakness of different models and frameworks.

Table 9 Analysis of Strength and Weakness of Different Models and Frameworks

Model/ Framework	Strength	Weakness
SCOR Model	- is a structured methodology for identifying business improvement opportunities (Holmberg, 2000), - provides a standard supply chain process reference model and framework (Bolstorff, 2003; Theeranuphattana & Tang, 2008); - provides a standardize terminology and multi-level performance metrics with benchmarks and best practices data sources (Theeranuphattana & Tang, 2008); - provides a common language to communicate between organizations in the supply chain by providing standardized definitions for processes, process elements, and metrics (Holmberg, 2000; Huang, Sheoran & Keskar ,2005; Theeranuphattana & Tang, 2008);	- is mainly focuses on processes and efficiency but not on strategy (Theeranuphattana & Tang, 2008); - complicated and is not easily understood and implemented. Not every organization has capability and willing to explore opportunities offered by this model. Implementing this model requires highly skilled technical managers (Huang, Sheoran & Keskar ,2005);
Balanced Scorecard	- is the most widely accepted to be implemented (Mahidhar, 2005); - is clear linkage between the strategies of an organization and the performance measures (Acharyya, 2008; Adams	- is clearly focused on customers; however it does not consider the competitor perspective (Neely, Gregory, Platts, 2005; Tangen,

	& Neely, 2002; Holmberg, 2000); - the four perspectives are cause-and-effect relationships to describe how the four dimensions of performance are connected (Holmberg, 2000); - is a tool to communicate strategic objectives and measures in the organization (Holmberg, 2000); - it is a good vehicle for structuring performance measures (Adams & Neely, 2002) and provides strength methodology of selecting and delivering strategies (Acharyya, 2008); - the four perspectives are closely match the main stakeholder of the organization (especially as the employees tend to be discussed in the fourth, learning and growth, area) (Adams & Neely, 2002); - has a clear attempt to model the main drivers of future performance, as required by each area to question "What must we do in order to satisfy the expectations of our . . .?" to be considered, and then generated the appropriate responses (Adams & Neely, 2002); - combines issues that are necessary to deliver shareholder value while meeting the satisfaction of customers (Acharyya, 2008); - highlights the requirements of organizational learning and growth perspectives while selecting the internal value creating processes for customers (Acharyya, 2008).	2004); - is constructed as a monitoring and controlling tool rather than an improvement tool (Tangen, 2004); - provides little guidance on how the appropriate measures can be identified, introduced and used to manage business. (Neely et al., 2001); - is primarily designed to provide senior managers with an overall view of performance. Thus, it is not intended for (nor is it applicable to) the factory operations level. (Mahidhar, 2005; Tangen, 2004).
Performance Prism	- is more comprehensive view of different stakeholders (such as investors, customers, employees, alliance partners, suppliers, etc.) than other frameworks (Mahidhar, 2005; Tangen, 2004); - questions the company's existing strategies about the stakeholder satisfaction before the process of selecting measures is started. So that the framework ensures that the performance measures have a strong foundation (Tangen, 2004).	- is relatively little known for implementations; - The framework is too wide and offers little about how the performance measures are going to be realized.(Tangen, 2004); - pays little or no consideration on the existing performance measurement systems that companies may have in place (Medori and Steeple, 2000 as cited in Tangen, 2004); - has little guidance for the actual selection and implementation of the measures selected;
Beamon's Model	- links the performance measures to the supply chain purpose.	- is relatively little known for implementations; - has little guidance on the actual selection and implementation.
Chan and Qi's Model	- offers both structural and procedural performance measurement frameworks (Folan and Browne, 2005 as cited in Theeranuphattana & Tang, 2008); - is a systems thinking approach model (Chan & Qi, 2003a, b; Chan et al., 2003); - provides calculation for different metrics to be numbers that are comparable and can be used for benchmark.	- is difficult to apply the model because it involves too many performance measures and too much data (Theeranuphattana & Tang, 2008); - lacks clarity on how to define supply chain metric. (Theeranuphattana & Tang, 2008); - Implementing this model requires technical skill to convert performance data into performance index.

PROPOSED FRAMEWORK FOR THE THAI JEWELRY SUPPLY CHAIN

According to the widely implemented of the BSC, and its strengths, the BSC was selected as a framework to develop the model for the supply chain of jewelry industry by considering the BSC collaboration between suppliers and customers in the supply chain. The proposed conceptual framework for a Thai jewelry supply chain, sterling silver jewelry supply chain; was established as depicted in the Figure 9 and could be explained as follows:
A supplier's *customer perspective* could affect a customer's *internal business process perspective*. For instance, if a silver bar retailer improves its customer perspective performance (such as order lead time, delivery performance), the internal business process perspective (such as total cycle time, capacity utilization) of its customer, a sterling silver jewelry industry; should improve. Similarly, this applies to a sterling silver jewelry industry as a supplier and its exporter as a customer, and the other links in the supply chain.

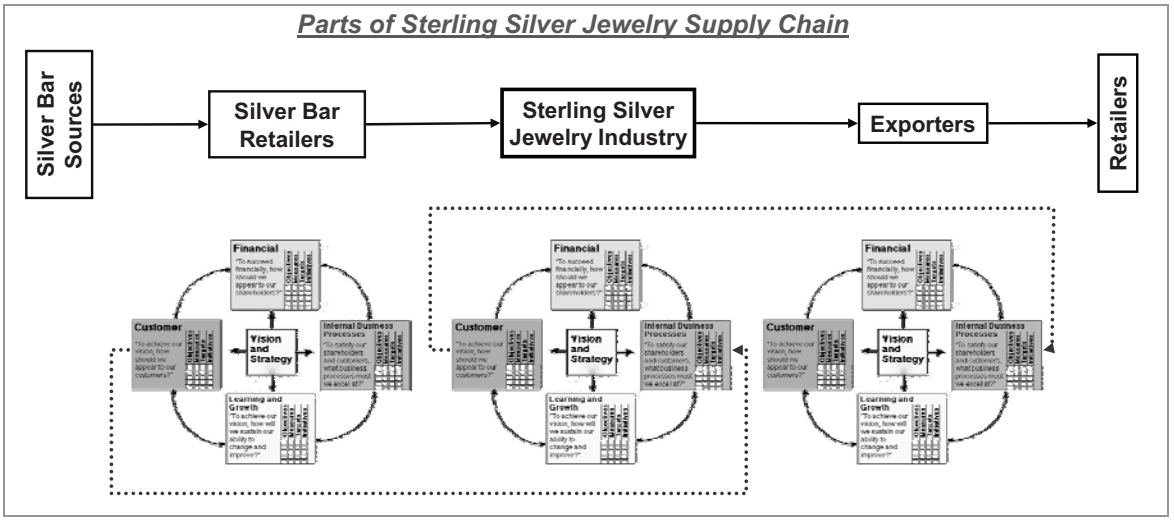

Figure 9 The Balanced Scorecard Collaborative between Supplier and Customer in the Sterling Silver Jewelry Supply Chain

CONCLUSIONS

The study reveals that there is no single approach or a set of performance metrics that is appropriate for every supply chain performance. However, every approach provides information required by management such as the historical performance, existing of problems, trend information, etc; so that the decisions can be made based on facts, not on supposition, emotion, faith or intuition (Jensen, 2000; Parker, 2000; Gunasekaran & Kobu, 2007). The performance measurement system, metrics, and frameworks discussed herein can provide a guideline for developing the customized supply chain performance measurement systems. The next milestone is to develop the model for evaluating the supply chain performance of the Thai jewelry industry by using the results from this study.

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LEANER THAN THOU - LINKING LEAN PRODUCTION, DFMA AND PRODUCTION REGION IN THE AUTOMOTIVE SECTOR

Mikael H. Ehrs
University of Vaasa, Vaasa, Finland

Tauno Kekäle, University of Vaasa, Vaasa, Finland
tke@uwasa.fi

ABSTRACT

The Asian (Japanese) lean production methods won considerable acclaim with the advent of the book "The Machine That Changed the World" by Womack, Jones and Roos. Design for Manufacture and Assembly (DFMA) is a lean tool aimed at reducing the parts usage and assembly time of the product. It is said that the two principles are connected, and that Asian automobile manufacturers are well versed in this tool. It should be possible to test this claim by comparing the service time and parts data of altogether twelve Asian, North American and European cars, on the basis of collision insurance data from 1990-1991.

This work will attempt to answer two questions: will Asian cars be leaner in design than North American and European, and will the cars' results be so close for different companies in the same region that something can be said about the region's expertise? Finally, what cars will in fact come out on top and bottom in the test? The analysis involves performing Chi squared tests on the significance of production region in using "lean" assemblies, and visual and qualitative evaluation of the test data.

INTRODUCTION

"*The Machine That Changed the World*" is today considered to be *the* book that opened the eyes of the wider public to the concept of lean production.. The excellence of the Japanese best production practises in the automotive industry has since become a matter of certainty, being adopted and capitalized on throughout the industrial world.

In later days, however, much of the lean productivity improvement has realized, rather, in the field of lean design. The Development of the leaner, sparer, cheaper and more easily produced car is a strategic R&D focus for the world's auto makers. According to "*The Machine That Changed the World*" the Asian automakers dominate(ed) also this aspect of development – the Asian cars were simply more manufacturable than those of their peers. This was the clear result of an internal auto industry manufacturability ranking survey carried out by the MIT International Motor Vehicle Program (Womack, Jones & Roos. 1990: 96-97)

However, innovation in lean design should not necessarily be the prerogative of the Asian producers, since the elimination of excess components and unnecessary complexity would be a most basic step in the design processes of any company. Design for Manufacture and Assembly (DFMA) is a design tool focused on reducing the parts count and assembly time of a product, and has been a popular method of achieving cost savings and process improvements since the early eighties.

In this exploratory work the strength of the link between Design for Manufacture and Assembly (DFMA) and lean production is investigated, seeing whether manufacturability and

excellence in lean production follow hand in hand. It should be possible to test this claim by comparing the service time and parts usage of altogether twelve Asian, North American and European cars, on the basis of independent data – in this case figures provided by Mitchell International's Collision Estimating Guides from 1990-91, around the time of *The Machine*.

The answers to two main questions are sought: will the Asian excellence in lean production show Asian cars to be leaner in design than their North American and European counterparts? And will the cars' results be close enough for different companies in the same region that something can be said about the whole region's expertise? Seeing what cars will come out on top and bottom in the test will be an added point of interest, as an indicator of individual innovation prowess in lean design.

BROWSING FOR THE RIGHT CARS AND PARTS

First of all, the cars. The easiest class of cars to compare is probably the sedan type family car, used and marketed over the whole globe as it is. Furthermore, the general family sedan is often a front motor, front wheel drive, four door car, available with a five gear manual transmission (even though automatic transmission is certainly more common in the United States). There are differences in equipment levels and superficial design between brands, but the basic structures used are often similar. In addition to these features, the price level of the car and the motor size should preferably be similar between models. This to guarantee that that the level of extra equipment and trimmings remain at the lowest possible level, and that the car remains a certain size.

Based on these parameters, it was eventually possible to make a selection of twelve similar, suitable cars manufactured in 1990-91 – four Asian, four European and four North American – present in the Mitchell Collision Estimating Guides. These, together with their specifications for price, measurement, drive type, engine and country of origin are presented in Appendix A.

The cars themselves are all well-known models, much sold, and much used. For instance, the Ford Taurus is still in production, and since its launch in 1986, it has sold over 6,7 million units worldwide as of 2007 – the fifth best selling North American model in Ford's history (Cars-directory 2009a). The Toyota Camry, similarly, was the best selling car in the United States for nine out of ten years between 1997 and 2007 (Cars-directory 2009b). Honda Accord was the best-selling Japanese car there for 20 years (1982-97) and has sold around ten million units in the U.S. market alone (Cars-directory 2009c).

The list continues. The Volkswagen Passat has been one of Volkswagen's best-selling and most-profitable models in nearly every market, the Peugeot 405 was voted European Car of the Year for 1988 by the largest number of votes in the history of the contest and the Nissan Bluebird is one of the longest-running nameplates from a Japanese automaker (started 1957) (Cars-directory 2009d,e,f). Even the Saab 900 was a big brand for the small producer, with around a million units sold in all (Cars-directory 2009g). Together, these cars made out a sizable portion of the world's car fleet at one point in time.

For these twelve cars a good number of sub-assemblies was then chosen, for comparison of service time and parts data. This choice was dictated much by availability in the collision guides, and the need for similarity by all of the chosen

cars – importantly, the assemblies chosen had to be general enough to be present on all models. The chosen assemblies are visible in appendices B and C

In these tables, the service times are presented in hours and tenths of hours (6 minutes), and categorized by the extent of the repair procedure: R&I (Repair and Install), O/H (Overhaul) or Refinish. The terms are defined as: "Remove and Install: Remove a part or assembly, set it aside and reinstall it later." "Overhaul: Remove an assembly, disassemble, clean and visually inspect it, replace needed parts, reassemble and reinstall on the vehicle making any necessary adjustments." And finally "Refinish: a certain panel is removed, prepared, repainted and re-installed on the vehicle." (Collision Estimating Guide Imported 1991: P3.)

DIGGING IN THE DATA

The tables in appendices B and C are both built in the same way: the higher table showing the actual count – actual service time in hours, or actual parts count. The lower table is a derivative of the higher – it shows how much each measurement above differs from the average of that assembly type. The average is at the base of each column in the higher table. One assembly type is shown as one column, each model's data for that particular assembly shown there. One car model represents one row in each the table. So, for instance, we can see that the average time to overhaul the front suspension of the cars is 3,8 hours. However, on the Honda Accord you can do this somewhat faster: it only takes 3,6 hours. And as we can see in the lower table, this is 4 percent faster than the average.

This data can be used for further analysis. On the basis of the frequency of "faster-than-average" or "sparer-than-average" cells in the lower tables, we can devise a chi squared test to see whether production region has any impact on the usage of more "lean" assemblies. The test data is simply a count of how many unmarked cells the tables contain for each region, for service times and parts respectively. For example, The Asian region of lower part of the table in appendix A (consisting of the Honda Accord, the Hyundai Sonata, the Nissan Stanza/Bluebird and the Toyota Camry) contains 36 unmarked (faster than average) cells out of 52 total.

The test is done in the usual way. The null hypothesis of the test is that production region and frequency of "faster-than-average" or "sparer-than-average" results are unrelated. The calculation compares the actual, observed values with the expected values; the difference is squared and divided by the expected values. The expected values are calculated on the basis of row and column totals of the observed values. And in the end we get two values to be compared with the critical value – the table value from the Chi squared tables is in this case 5,991: two degrees of freedom and a 95 % confidence interval.

SERVICE TIMES

"Faster-than-average" assemblies		"Slower-than-average" assemblies	
Asian	**36**	**16**	52
European	**17**	**35**	52
North American	**32**	**20**	52
	85	71	156

Degrees of freedom	2
Probability	0,95
Chi^2 table value	5,991
Chi^2 chritical value	15,561

Since 5,991<15,561 we REJECT the null hypothesis that origin and "faster-than-average" results of service times are unrelated, at a 95% confidence level

Fig. 1. Individual model results

And the comparison shows, in the case of service times, that since 15,561 is greater than 5,991, we REJECT the null hypothesis that production region and frequency of "Faster-than-average" assemblies are unrelated, at a 95% confidence level. Production region does matter. In fact, the results are so strong that they hold even on a confidence level of 99,9 % (with a critical value of 13,816).

And to see which region wins the comparison, it is only necessary to look at the regional breakdown: the Asian producers have considerably more "fast" assemblies than the Europeans and somewhat more than the North Americans. In other worlds, the Asian cars use assemblies that are easy to assemble more often than all others. A result that is thoroughly supported by the theory, of course. If anything, it is only surprising that the Asian advantage was not greater than this.

PARTS COUNT

"Sparer-than-average" assemblies		"Crammed-than-average" assemblies	
Asian	**30**	**28**	58
European	**33**	**25**	58
North American	**40**	**19**	59
	103	72	175

Degrees of freedom	2
Probability	0,95
Chi^2 table value	5,991
Chi^2 chritical value	3,258

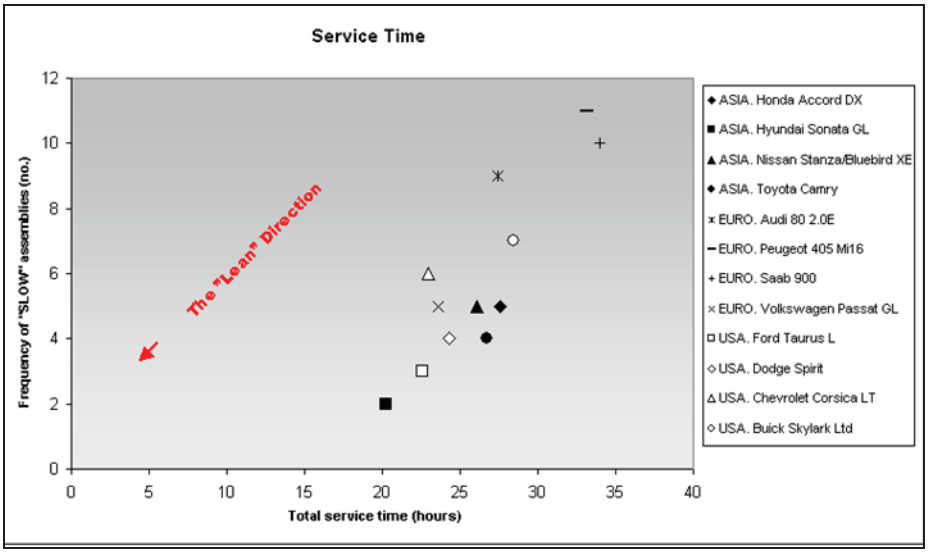
Since 5,991>3,258 we ACCEPT the null hypothesis that origin and ""sparer-than-average" results in parts count are unrelated, at a 95% confidence level

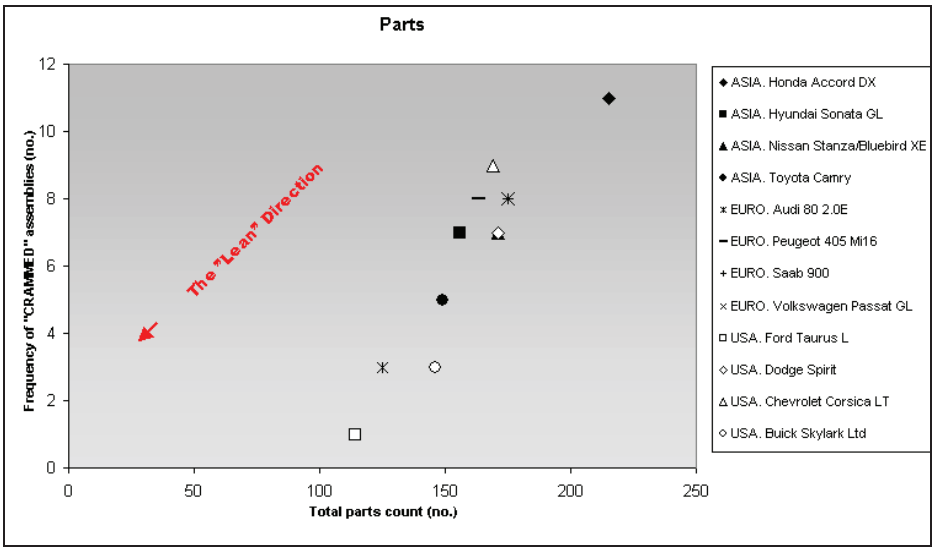
Fig. 2. Individual model results (Parts count).

However, the second comparison – the parts count – looks somewhat different. The test's output value is only 3,258. The critical value, of two degrees of freedom and a 95 % confidence interval, is still 5,991. In this case, since 3,258 is less than 5,991, we must

ACCEPT the null hypothesis that production region and frequency of "Sparer-than-average" assemblies are unrelated, at a 95% confidence level. In fact, we can only reject the null hypothesis at an 80 % confidence level (with a critical value of 3,219).

At this point one might begin to doubt the correlation of the two categories. Perhaps DFA and DMA are not as closely linked as we believed. However, if the correlation coefficient of the similar assemblies in the service time and parts count tables is calculated we see that this is still not the case. The result, as it turns out, is a significantly high, positive correlation: 0,505. The reason for the differing results in times and parts will probably have to be sought elsewhere.





At this point it is also possible to address the second research question, concerning the regional cohesion in the data results. This is easily done by visual means, graphing the total service time against the frequency of "slower-than-average" results and the total parts count against "crammed-than-average" results (see figures two one and two).

The service time graph shows us a relatively high degree of regional cohesion. Not perfect such, of course, but the cars are generally quite closely grouped into three distinct areas. The Asian producers probably lie furthest towards origin, but the North Americans are very close.

Finally, the Europeans lie farthest away, as was expected in accordance with the theory. Again, we are struck by the fact that the difference between the Asian and North American producers is so small, when all is said and done.

But we can note that the Japanese car models are tied very closely to each other: their car models are very similar to each other in DFA rating. Interestingly enough, the fourth Asian producer, South Korean Hyundai, is an outlier, in the even more lean direction. In comparison, the European and North American producers' values are more individual.

The other graph (figure two) showing parts count total and the frequency of "crammed" assemblies, on the other hand, does not indicate any particular regional cohesion. The car models are if anything spread almost evenly over the "lean line", from most lean to least. But, if a distinction has to be made, the Asians seem to lie the farthest out, the Americas closest in. At this point we should remember the Chi squared –test's outcome, that there is no statistically significant regional significance for the parts count, and that the spread between the regions' producers is undoubtedly large. But nevertheless, it is interesting to note this unusual turn of events.

Now it is also possible to say something about the individual successes of the car models. The winner of the lean design "competition" when talking about service time is clearly the Hyundai Sonata. Conversely, the Saab 900 probably finds its place at the far end of the lean line. The Saab is hardly a surprising candidate for this dubious honour, Saab being a generally smaller producer than the other – it is not strange that they would have a lower focus on DFA than its competitors. Furthermore, the Swedish focus on safety issues may or may not be playing its part in inflating the Saab's service time.

In the other graph, the parts count figure, the winner is Ford Taurus and the loser Honda Accord – unambiguously so. Both results are interesting. If one reviews the background of Ford Taurus, however, it is said that the focus on design in this model (first generation, 1986-1991) was tangible. In fact, Ford Taurus was a very important new product to the Ford Motor Company,

the car that would end the bad streak of money and market share loss. The goal was to create something entirely new –"a "world class" car with styling, engineering, and performance equal to or better than any similar sized car" (The Henry Ford 1999). In doing this, design engineers, stylists, manufacturing engineers, and marketing people were brought together, and the design was created as a complete unit. Ford also used benchmarking to identifying competitive cars with the best features and trying to create equal or improved versions of them in the Taurus. It is also mentioned that "great emphasis was put on design for quality low cost manufacturing." (The Henry Ford 1999.) This very lean way of acting may well account for the Taurus' overall high score in the comparison, and especially its good DFM ranking.

And the Honda Accord? Why would a car produced by one of the world leaders in Japanese lean Production come last in this kind of comparison? Again, one can find possible explanations in the model's history: the fourth generation of the model was launched in 1990, and it sported several new engineering features. It came with a new electronic fuel injected engine, an all aluminium power train, an electronically controlled rear engine mount to reduce low frequency noise and vibration (Cars-directory 2009c). The ambitiousness of this

very complete overhaul may well have served to increase the parts count, drawing down the overall DFM value.

CONCLUSIONS AND PLANS FOR FURTHER STUDY

As we can conclude, the Asian advantage in manufacturability is present in our figures, but to a lesser degree than expected. While the Asian producers show strength in reduced service times, closely followed by their American colleagues – the parts count analysis, on the other hand, is dominated by the North American producers. That analysis, unfortunately, shows low statistical significance, mainly because of the low regional cohesion: regional cohesion between producers is only somewhat visible in service times, not in parts count. Now, where should we seek the explanation for these unusual results?

Rather than beginning to suspect unknown factors or even doubting the linkage between DFMA and lean design, it is probably wise to attack the weakest point first: the shallow data basis. First of all, a data analysis based on twelve vehicles only, will not really be able to say anything certain about a region's output, nor really anything about a company's extended production. What the Chi squared analysis showed was the success of these Asian, American and European cars, and the fact that individual design successes stand out so pointedly (e.g. the Ford Taurus) only goes to show that a sufficiently large statistical database has not been established. As we could see, the correlation between service times and parts count (as a proxy for DFA and DFM) was high, but not a hundred percent. Probably, the individual car models in this case displayed large discrepancies between the two fields simply because of reasons unrelated to this analysis, i.e. model development stage, the trade-off between simplicity of design and model quality, etc. This sort of data variation could only be reduced by increasing the sample size.

Furthermore, this data analysis was, of course, a point sample: one year only, and only one type of car presented. The automakers of the IMVP manufacturability survey (Womack et al. 1990: 96-97), ranking their competitors, have most probably seen a wide spectrum of cars over a long period of time, allowing them to focus on the trend rather than the year's crop. This would certainly smooth out wilder peaks and slumps in a company's production.

The logical next step, then? To broaden the scope of the data basis, over several years and more models. This, if nothing else, will provide a more secure basis to make contradictory assumptions from. And how will this best be achieved? The only way to expand the year 1990 database is to allow other body types and layouts into the comparison, since the sedan family model comparison was already used in this work. The different models will not be directly comparable to each other, but the Chi squared type analysis of how often a specific car model has displayed "above average" or "below average" results should be feasible to perform on an extended model database too. The economy car class has several different possible subsets based on door layout and motor size, the family car class could be augmented by a station wagon class and a separate section for sports car or luxury cars could also be a possibility.

To broaden the spectrum over further years simply means gathering more Michell International Collision Estimating Guides and repeating the process. To move forwards in time would give the possibility to see whether the different production regions have really started to converge in their design practises, and whether the Asian automakers have been

able to keep their grip on the lead position. A sample point close to our time, and possibly one in between, would already mean a much clearer picture of what has been happening since the time of The Machine.

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APPENDIX A

THE SELECTED CARS

	Min	Max		Honda Accord DX	Hyundai Sonata GL	Nissan Stanza/Bluebird XE	Toyota Camry Gli Kat	Audi 80 2.0E	Peugeot 405 Mi16	Saab 900 i Kat	Volkswagen Passat GL	Ford Taurus L	Dodge Spirit	Chevrolet Corsica LT	Buick Skylark Ltd
Year				-91	-91	-91	-91	-90	-90	-90	-90	-91	-91	-91	-90
Base price, Road&Track, AM$	10070	15300	$	12345	10700	11900	11948	N/A	15300	N/A	14990	13717	10925	10070	10725
Base price, Autotalli.fi, EUR	23025	29584	€	23950	N/A	N/A	23025	28424	27953	24135	29584	N/A	N/A	25195	N/A
Country of origin				Japan, U.S.A.	South Korea	Japan	Japan, U.S.A.	Germany	France	Sweden, Finland	Germany	U.S.A.	U.S.A.	U.S.A.	U.S.A.
Body type				Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan	Sedan
Body/seats				4D/5	4D/5	4D/5	4D/5	4D/5	4D/5	5D/5	4D/5	4D/6	4D/5	4D/5	4D/6
Drive layout*				F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F	F/F
Length, cm	176,0	188,4	cm	184,8	184,3	179,9	182,1	176,0	177,7	184,5	180,0	188,4	181,2	183,4	180,0
Length, inch	447,0	478,5	in.	469,4	468,1	456,9	462,5	447,0	451,4	468,6	457,2	478,5	460,2	465,8	457,2
Width, cm	66,5	70,8	cm	67,9	68,9	66,9	67,4	67,6	67,5	66,5	67,1	70,8	68,1	68,2	66,6
Width, inch	168,9	179,8	in.	172,5	175,0	169,9	171,2	171,7	171,5	168,9	170,4	179,8	173,0	173,2	169,2
Height, cm	33,5	56,2	cm	53,9	55,4	54,1	54,1	54,3	55,2	56,1	56,2	54,1	33,5	56,2	52,1
Height, inch	85,1	142,7	in	136,9	140,7	137,4	137,4	137,9	140,2	142,5	142,7	137,4	85,1	142,7	132,3
Curb weight, kg	1177	1438	kg	1243	1286	1295	1399	1438	1232	1281	1184	1383	1290	1243	1177
Curb weight, lb	2595	3170	lb	2740	2835	2855	3085	3170	2715	2825	2610	3050	2845	2740	2595
Engine type	95	150	bhp	125-bhp sohc 16V inline-4	116-bhp sohc 12V inline-4	138-bhp 12V sohc inline-4	115-bhp dohc 16V inline-4	110-bhp sohc inline-4	150-bhp dohc 16V inline-4	128-bhp dohc 16V inline-4	134-bhp dohc 16V inline-4	105-bhp ohv inline-4	100-bhp sohc inline-4	95-bhp ovh inline-4	110-bhp ovh inline-4
Cylinder displacement, cc	1905	2507	cc	2156	2350	2389	1998	1984	1905	1985	1984	2499	2507	2190	2471
Transmission**				5M	5M	5M	5M	5M	5M	5M	5M	5M	5M	5M	5M
Suspension front/rear				ind/ind	ind/beam	ind/ind	ind/ind	ind/ind	ind/ind	ind/beam	ind/beam	ind/ind	ind/beam	ind/beam	ind/beam
Brakes front/rear				disc/ drum	disc/ drum	disc/ drum	disc/ drum	disc/ disc	disc/ disc	disc/ disc	disc/ disc	disc/ drum	disc/ drum	disc/ drum	disc/ drum
Road & Track Classification				Family	Family	Family	Family	Family	Family	N/A	Family	Family	Family	Family	Family

* F/F stands for Front motor/Front wheel drive

** 5M stands for Manual gearbox, 5 gears

APPENDIX B

SERVICE TIME (PERCENT OF AVERAGE)

SERVICE TIME (HOURS)		Front suspension O/H	Rear suspension R&I	Steering linkage/gear R/I	Front door R&I Door Assy	Rear door R&I Door Assy	Quarter panel Refinish outside	Front bumper O/H	Front fender R&I assy	Hood R&I assy	Front drive axle R&I	Rear bumper O/H	Seat (driver's) R&I	Engine/transmission R&I assy	Sum Total (H)
Honda Accord DX	ASIA	3,6	2,5	2,6	1,2	1,2	2,3	1,8	0,8	0,4	1,1	1,3	0,3	8,5	27,6
Hyundai Sonata GL	ASIA	2,5	2,5	1,4	0,5	0,3	2,3	1,5	1,2	0,4	1,0	1,0	0,4	5,2	20,2
Nissan Stanza/Bluebird XE	ASIA	3,2	2,0	3,6	0,4	0,4	2,5	2,2	1,5	0,6	0,9	1,8	0,3	6,7	26,1
Toyota Camry Gli Kat	ASIA	3,4	1,5	3,0	0,7	0,5	2,4	1,6	1,2	0,5	2,1	1,3	0,3	8,2	26,7
Audi 80 2.0E	EURO	4,7	2,5	1,6	1,0	0,8	2,2	2,0	2,6	0,6	0,9	2,0	0,5	6,0	27,4
Peugeot 405 Mi16	EURO	5,5	3,0	3,5	1,0	1,0	2,1	2,0	1,3	0,6	1,6	1,6	0,4	9,5	33,1
Saab 900 i Kat	EURO	6,4	3,0	1,2	0,8	0,8	2,8	2,0	5,0	1,0	1,9	1,8	0,3	7,0	34,0
Volkswagen Passat GL	EURO	3,5	2,5	1,7	0,7	0,8	2,4	1,2	1,8	0,6	1,1	1,2	0,5	5,6	23,6
Ford Taurus L	USA	3,3	2,0	2,3	1,0	1,0	2,1	1,0	1,5	0,6	1,3	0,9	0,3	5,3	22,6
Dodge Spirit	USA	3,5	1,5	2,6	1,0	0,4	2,4	1,7	1,7	0,4	1,5	1,3	0,3	6,0	24,3
Chevrolet Corsica LT	USA	2,7	1,5	2,6	1,0	0,8	2,1	2,2	1,5	0,5	1,5	1,6	0,3	4,7	23,0
Buick Skylark Ltd	USA	2,7	1,5	2,7	0,5	0,8	2,5	3,0	1,5	0,5	1,5	2,5	0,3	8,4	28,4
Column Average		3,8	2,2	2,4	0,8	0,7	2,3	1,9	1,8	0,6	1,4	1,5	0,4	6,8	

SERVICE TIME (PERCENT OF AVERAGE)		Front suspension O/H	Rear suspension R&I	Steering linkage/gear R/I	Front door R&I Door Assy	Rear door R&I Door Assy	Quarter panel Refinish outside	Front bumper O/H	Front fender R&I assy	Hood R&I assy	Front drive axle R&I	Rear bumper O/H	Seat (driver's) R&I	Engine/transmission R&I assy
Honda Accord DX	ASIA	-4 %	15 %	8 %	47 %	64 %	-2 %	-3 %	-56 %	-28 %	-20 %	-15 %	-14 %	26 %
Hyundai Sonata GL	ASIA	-33 %	15 %	-42 %	-39 %	-59 %	-2 %	-19 %	-33 %	-28 %	-27 %	-34 %	14 %	-23 %
Nissan Stanza/Bluebird XE	ASIA	-15 %	-8 %	50 %	-51 %	-45 %	7 %	19 %	-17 %	7 %	-34 %	18 %	-14 %	-1 %
Toyota Camry	ASIA	-9 %	-31 %	25 %	-14 %	-32 %	2 %	-14 %	-33 %	-10 %	54 %	-15 %	-14 %	21 %
Audi 80 2.0E	EURO	25 %	15 %	-33 %	22 %	9 %	-6 %	8 %	44 %	7 %	-34 %	31 %	43 %	-11 %
Peugeot 405 Mi16	EURO	47 %	38 %	46 %	22 %	36 %	-10 %	8 %	-28 %	7 %	17 %	5 %	14 %	41 %
Saab 900	EURO	71 %	38 %	-50 %	-2 %	9 %	20 %	8 %	178 %	79 %	39 %	18 %	-14 %	4 %
Volkswagen Passat GL	EURO	-7 %	15 %	-29 %	-14 %	9 %	2 %	-35 %	0 %	7 %	-20 %	-21 %	43 %	-17 %
Ford Taurus L	USA	-12 %	-8 %	-4 %	22 %	36 %	-10 %	-46 %	-17 %	7 %	-5 %	-41 %	-14 %	-22 %
Dodge Spirit	USA	-7 %	-31 %	8 %	22 %	-45 %	2 %	-8 %	-6 %	-28 %	10 %	-15 %	-14 %	-11 %
Chevrolet Corsica LT	USA	-28 %	-31 %	8 %	22 %	9 %	-10 %	19 %	-17 %	-10 %	10 %	5 %	-14 %	-30 %

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REDUCING COMPETENCE GAP AND THE ENTERPRISE'S EFFECTIVENESS

Dr. Urszula Skurzynska-Sikora, Maria Curie-Sklodowska University, Poland
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 actual requirements of the environment compared with the actual competences of a company make the so-called competence gap which may be realized by the company's managerial staff to a different extent.

The paper presents the results of empirical studies performed in order to determine the activities leading to identifying and reducing competence gap, as well as the course of corporate learning processes 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 and the processes of corporate learning carried out in practice.
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.

Keywords: competence gap, reducing competence gap, company's effectiveness, processes of corporate learning

INTRODUCTION

The growing intensity of globalization processes, the increasing complexity or dynamics and the discontinuity of the changes occurring in the environment make contemporary enterprises face the need to continuously adapt to arising challenges. In order to ensure adequate effectiveness of an enterprise it is necessary to undertake repeatedly some coherent actions leading to reaching a permanent competitive advantage. An important role in gaining and maintaining such an advantage by enterprises is played by their knowledge-based internal resources, known as corporate competencies.

The idea of "corporate competencies" has been defined in many different ways, however, it can be stated generally that they are the enterprise's specific skills referring to the placement of its resources, together with its cognitive abilities which make it possible to undertake activities leading to reaching assumed goals. Corporate competencies of an organization include elements such as its unique, specific knowledge, experience and skills which have all been developed by this organization and which give it a competitive advantage. In the environment of knowledge-based economy, the role of competencies is increasingly important and it can be assumed that this tendency will continue.

Thus, it is necessary to identify continuously the environment's requirements – in the context of key competencies indispensable to create and strengthen a permanent competitive advantage, as well as the company's adequate reaction through the processes of corporate learning. The actual requirements of the environment set against the enterprise's current competencies make the so called "objective competence gap" which can be perceived to a different degree by the company's management board. The majority of enterprises are aware of this discrepancy, either in a situation when problems have already arisen or they anticipate such problems and confront them with the company's actual competencies. What is identified as a result is the so called "subjective competence gap" which gives an impulse to initiate corporate changes. The competence gap understood in this way can be defined as a discrepancy between the competencies remaining at the company's disposal, assuming their optimal use, and the competencies which are necessary to meet the company's aspirations.
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.

ORGANIZATIONAL COMPETENCIES

The idea of „organizational competencies" is defined in many different ways, however, there is an agreement that they are one of the vital factors determining the company's success. In the most general definition, competencies can be described as abilities to develop, co-ordinate and apply the available resources in order to implement the tasks and reach the objectives set by the company (1).

M. Bratnicki (3) distinguishes the idea of "*abilities*" which are attributed to individual human beings and the idea of "*competences*" which refers to the level of the whole organization. According to him, competences consist of integrating knowledge (the abilities of the individuals and resources) to reach a particular objective. Competences understood in this way are in fact the abilities of the people managing an organization, who have an influence on taking the most important decisions. These are the abilities to acquire the right resources, including people and to use them adequately to implement the adopted strategy.

Competences distinguish an organization in its environment and equip it with a competitive advantage. Just like in case of other resources which determine competitiveness, competences have to be assessed from the perspective of the type of business activity, they need to have the quality of rare goods and they must be difficult (or/and costly) to imitate. Thus competences of an organization (12):

- may be understood as an opportunity, an ability to reach a definite result on a particular level (an ability to perform particular assignments or to reach definite objectives),
- are always of relative nature and have to be referred to some standard, an assumed goal or assignment (competences to do what? and/or within what range?),
- are manifested through the ability to react in a way which is adequate to the requirements of a particular situation.

To sum up the considerations concerning competences, they may be defined as a combination of knowledge and abilities which reflect both the layers of basic (hidden) knowledge and the abilities which are indispensable to implement all the necessary tasks. Competences are based on the knowledge inherent in the sets of abilities of individual employees and the knowledge

remaining at the disposal of particular organizational units. Generally, it may be said that competences make the company's specific abilities concerning the distribution of its resources, its cognitive potential, enabling it taking up actions leading to reaching its goals. Organizational competences should be characterized by including (12):

- an organizational component, i.e. they should refer to co-ordinating and distributing the resources,
- an intentional component – they should result in deliberate actions aimed at ensuring coordinated distribution of the resources,
- a target component – co-ordinating the resources has to be aimed at reaching the company's aims.

A vital role in an enterprise is played by its core competences which are developed in the process of corporate learning.. Learning and competences are mutually interrelated. The learning process depends on the character of the company, it includes accumulating specific, resources, skills and experiences and transmitting them onto new products and processes. An analysis of core competences may be carried out with the use of a model called "core competences", developed by R.M. Grant and M. Javidan, which takes into account the relations between resources, skills, competences and core competences (5). The lowest level consists of tangible and intangible assets as elements which have a relatively lowest value for the enterprise. Intangible assets include eight basic categories related to technologies, building relationships with the client, the methods of negotiating agreements, data processing (e.g. specialist computer software), human resources, marketing, the company's location and th company's property (the so-called goodwill). The level of using the company's resources which determines the potential of a particular organization is known as its abilities. Competences are a set of abilities and know-how and are the effect of organizing and coordinating the individual links of the chain of values.

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. C*ompetence gap* may be understood as (12):

- „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.

Thus, competence gap is the difference between the current status of the company's competences and their desirable level. The idea of a "gap" understood as a lack, a deficiency has a pejorative tone as such. Likewise, competence gap which result in the following key, negative effects in the company:

- it hinders or even makes it impossible for the company to develop, or even poses a threat to its further existence,
- it hinders improving the company's competitive position,
- it hinders creating innovation: of products, processes or buisness models.

It should be noted, however, that competence gap may be motivating to introduce changes in the company and it orientates the processes of the organization's improvement.

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. Reducing the competence gap may occur due to a systematic introduction of the processes of organizational learning and thanks to knowledge management.

The model of identifying and reducing the competence gap, developed by a team supervised by professor A. Sitko-Lutek and including as its member the author of the present paper, comprises the following elements (12):

- *The aspirations of the owners and the managerial staff* - they determine their expectations concerning the image of the company, the rate and direction of its development, the role it plays in the local, regional or even national environment; they may also influence the preferred range of the company's activities;
- The owners and the managerial staff of companies are trying to find o*pportunities* which would make it possible to implement the aspirations; *threats* create a necessity to initiate activities aimed at their elimination, in order to fulfil the aspirations;
- Following the identification of threats or the choice of opportunities, there is an analysis and assessment of widely understood company's assets, including competences; it aims at determining to what extent the actual tangible assets and competences can be used to take advantage of the opportunities spotted or to reduce the threats hindering the fulfillment of the owners' aspirations and those of the managerial staff; if the enterprise does not have such competences, it may be concluded that there is a *competence gap;*
- The strategic options considered are a result of aspirations and express intentions taken into account after analyzing the opportunities and threats as well as competences; competences needed to fulfill aspirations which are not at the company's disposal are defined as *competence gap;*
- The assessment of the gap is supposed to determine the level of discrepancies, how far this hinders fulfilling the aspirations and the decision about its elimination is taken – complete (in a situation when the lack of particular competences makes it impossible to fulfill the aspirations of the owners and/or the managerial staff) or partial (when the lack of some definite competences makes it partly impossible to fulfill the aspirations of the owners and/or the managerial staff), or possibly just tolerating such a discrepancy (in a situation when it did not lead to difficulties which would make it impossible to fulfill the company's aspirations, which does not mean that it will be tolerated in the next period of functioning).
- *Organizational learning processes* are initiated through launching the aspirations of the owners and the managerial staff and they occur at every of the stages, though they may be observed most clearly while reducing the competence gap; they are of a cyclical character.

The distinguished elements of the model are universal, mutual relationships are different in the particular companies.

The differences in the approaches to defining organizational competences and thus the ways of identifying the competence gap cause a lot of difficulties in its practical definition. Managers usually recognize the gap as a deficiency in the competences possessed, which means in practice the discrepancy between the competences that are possessed and those desired, required or necessary to a different degree. The competence gap may be communicated by different signals, e.g.:

- worse market and/or economic and financial indices,
- endangered financial fluency or profitability,
- decreased total sales or sales dynamics,
- difficulties in controlling current problems related to company's functioning,
- problems concerning the adequate use of the possessed technology or launching products on the market,
- losing markets, clients, negative changes in sales structure,
- inadqeuate, inappropriate strategic decisions,
- impossibility to implement the previously adopted strategy,
- successful competitors, an increased distance in relation to competitors.

Identifying the above phenomena and reacting to them may lead to a fragmental treatment of the problem of the competence gap and reducing the problem to selected aspects of competence areas which, as a result, may hinder the solution of the problem. Typical competence spheres of a company, interesting to managers, include (6, 13):

- operating,
- information,
- research and development,
- quality management,
- supply,
- distribution,
- marketing,
- finance,
- organization and marketing,
- personnel.

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. (9). 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 (12):

- acquiring tangible assets,
- acquiring financial resources,
- introducing elements of knowledge management,
- finding specialists on the job market,
- acquiring competences from a business partner,
- co-operation with consulting companies,
- co-operation with research institutions,
- training (internal and external),
- building the company's own research-and-development potential,
- learning in action,
- learning from competition,
- outsourcing.

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) (8).

Specialist literature offers differnt approaches to the interpretation of this term. According to some authors, effectiveness means (2, 14):

- in the economic formulation – the relationship between the results and the expenditure expressed through basic measures, such as productivity, effectiveness, profitability etc.
- in the target formulation – the assessment of the extent to which the intended objectives have been implemented, taking into account the existing resources; this concept is derived from praxeology and it means that the higher degree of implementing the company's objectives and the lower expenditure of tangible assets, the more effective the company becomes and less time is consumed to reach theses objectives;
- in the systemic formulation – the assessment of the company's potential to survive and develop, resulting from the strength and density of the system, its position in the environment and the chances to maintain and improve this position; the basic source of effectiveness is the ability to acquire rare and valuable resources (understood as the sum of the assets remaining at the company's disposal, both tangible and intangible ones, such

as the employees' knowledge and skills, technologies, know-how etc.) which are useful for the company in its functioning and relations with the environment; the effectiveness is referred to the company itself, which means that the evaluation from the point of view of the whole organization and its internal or external groups of interest may be different;

- in the formulation of interest groups (*stakeholders*) – the assessment of the organization's potential to meet the needs of stakeholders (individuals or groups of people, inside and outside the enterprise who are interested in the results of its functioning; the main stakeholders include the owners (investors, stakeholders), employees, clients, suppliers, creditors, local communities, local authorities etc.); this is a broader perspective on the organization's objectives because it takes into account both the relationships of the company with its environment and the results of its functioning; it should be noted that almost each group of stakeholders communicates different needs regarding the company and, consequently, assesses its effectiveness differently, which proves that effectiveness is a complex and multi-dimensional idea and should be evaluated on the basis of different criteria and measures;
- in a multi-criteria formulation – the organization's potential to achieve varied objectives which can be formulated in different ways e.g. in the form of final goals (assets and their use, similarly to the target formulation), the effectiveness of entering – transformation processes – exiting (in a way similar to the systemic formulation), the effectiveness of economic measures and behavioral measures (indicating the functioning of the social sub-system) etc.; in practice varied detailed concepts of effectiveness assessment are offered, taking into account its different aspects.

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 (4):

- 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.

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.

The issues of assessing company's effectiveness in a multi-criteria formulation makes the subject of a number of specialist works. R.E. Quinn and J. Rohrbough developed the so-called model of competitive values (2) which is an attempt to integrate different effectiveness criteria and to distinguish four coherent sets created on the basis of the values taken into consideration by the subject which is involved in the assessment.
While constructing this model, an assumption was made that there is no single best criterion for assessing effectiveness and the choice of the measures used in practice for such assessment is subjective and is made depending on the values, preferences and interests of the subject making the assessment:

- structural: controlling (preferring values such as order, stability, predictability) as opposed to flexibility (change, adaptation to the expectations of the environment),

- organizational: people (preferences for the people in the organization and their interests) as opposed to the organization (preferences for effectiveness and the results of the organization as a whole).

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. Thus managers should answer four essential questions (7):

- How are we perceived by the clients? – the market perspective referring to the degree of satisfying clients' needs; measures applied in this sphere are e.g. market share measured with the proportion of sales on a given market, acquiring new clients, maintaining the existing clients, clients' satisfaction, client's profitability.
- What do we need to stand out? – the perspective of internal processes concerning improving the effectiveness of work, lowering costs, reducing the length of the production cycle etc.; the essence of this particular area of effectiveness is reducing the use of the means of production per unit of product; the adopted measures are e.g. productivity, cost, time;
- Can we continue improvement and create value? – the perspective of innovation and learning, determining to what degree the company develops new products and markets, creates or acquires new technologies and skills; it makes the basic determinant of future success; the measures applied in this dimension are e.g. the percentage of creative initiatives in the recent years which resulted in new products or improved manufacturing processes, the current store of "ideas bank" which are being implemented or at the stage of preparation, current expenses on acquiring new knowledge and information technologies which will facilitate the employees' co-operation in creating new products;
- How do we care about our stakeholders? – the financial perspective measured with indices such as e.g. profit, profit rate, profitability, sales volume.

An interesting approach to assessing the effectiveness of an organization was put forward by G.A. Rummler and A.P. Brache (11). 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 (11):

- the level of the whole organization – emphasis is put on the relationships between the basic elements of the organization and the market on which it functions; factors affecting effectiveness include: strategy, objectives of the organization as a whole and the methods of their measurement, organizational structure, the method of using the resources,
- the level of the process – refers to work performance, the way the results flow through the organization; the effects are a consequence of inter-departmental processes flowing through the organization, such as e.g. developing new products, supply process, manufacturing process, sales process, distribution process, invoicing process, vindication process;

- the level of the position – it includes the employees working on individual positions implementing the activities which make the processes; variables affecting effectiveness on this level include: the methods of recruitment and promotion, task ranges and employees' responsibilities on particular positions, work standards, feedback information, rewards and training.

The second dimension, the need for effectiveness, is influenced by the results obtained on each level of the organization, which include (11):

- objectives determined by means of standards reflecting clients' expectations concerning e.g. quality, quantity, delivery time and time of implementation and the cost of the product and the service;
- designing methods – organizational structure, organizing the process and work place require some indispensable elements configured in a way which will facilitate effective implementation of the objectives;
- management methods – each of the three levels of effectiveness analysis needs an adequate method of management which will facilitate meeting the objectives.

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.
In order to help an enterprise meet the changing requirements of the environment and also the owners' expectations, managers have to care about its effectiveness. In these conditions the company has to be very flexible to continue functioning, and significant difficulties are faced when trying to transmit a formulated strategy onto actual, practical actions, as well as measuring the effectiveness of their implementation in the context of the company as a whole.

COMPANY'S EFFECTIVENESS IN THE LIGHT OF RESEARCH

Research methods

Continuous changes occurring in the environment result in new conditionings concerning the functioning of companies which are facing new challenges posing both opportunities for their development and threats for their functioning. In order to meet such challenges, enterprises have to permanently monitor the environment and to identify the following requirements – in the context of core competences indispensable to create and strengthen their permanent competitive advantage, and also to react adequately through undertaking adaptive actions aimed at reducing the competence gap which occurs. A significant role is played by learning processes.

The empirical studies performed were supposed, among others, to determine a set of key resources and skills necessary to create and maintain a permanent competitive advantage, to identify the company's competence gap and to initiate actions directed towards reducing it as a consequence of corporate learning, to recognize differences in the learning process and also to determine the factors which support or hinder the identification of changes in the competence gap.

On the basis of the research model which is presented in Figure 1, a questionnaire for a categorized interview was developed.

The research was carried out in 56 Polish companies of varied size. The structure of the research sample is as follows:

- 14.3 % - small businesses (employing below 50 people),
- 51.8 % - medium-size companies (staff between 50 and 249 people),
- 3.9 % - big companies (employing above 250 staff).

RESULTS

Respondents' interpretation of company's effectiveness

The professional literature, as it was mentioned earlier, presents the idea of effectiveness in a number of different ways. The results of the empirical studies confirmed the fact that managers also interpret the idea of effectiveness in a varied way.
The respondents could select a number of different ways of understanding "effectiveness", presented in a list. The results, presented in Table 1, show that the perception of the essence of effectiveness is slightly different in different companies, depending on their size.
A prevailing number of the respondents (66.1% on the average, and 73% in the group of big enterprises) sees effectiveness as effective actions, that is the degree to which the intended objectives can be reached.

More than 57% of the respondents believe that a company is efficient when it obtains a positive financial result and when it increases its market share. Identifying effectiveness with a positive financial result is least common in big companies (47.4%).
A relatively low percentage (19.6%) of all the respondents understand effectiveness as a tool for improving the company's competitiveness. Only 14.3% of the respondents believe that effectiveness is related to the company's balanced functioning in the environment.
In comparison to big and medium-size organizations, managers in small companies pay more attention to their clients' satisfaction and how fast they adapt to the latter's needs. What is vital to them, is also an increase in sales income and a systematic improvement of the financial performance.

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. For an organization which is market oriented understanding effectiveness in such categories is less typical.

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.

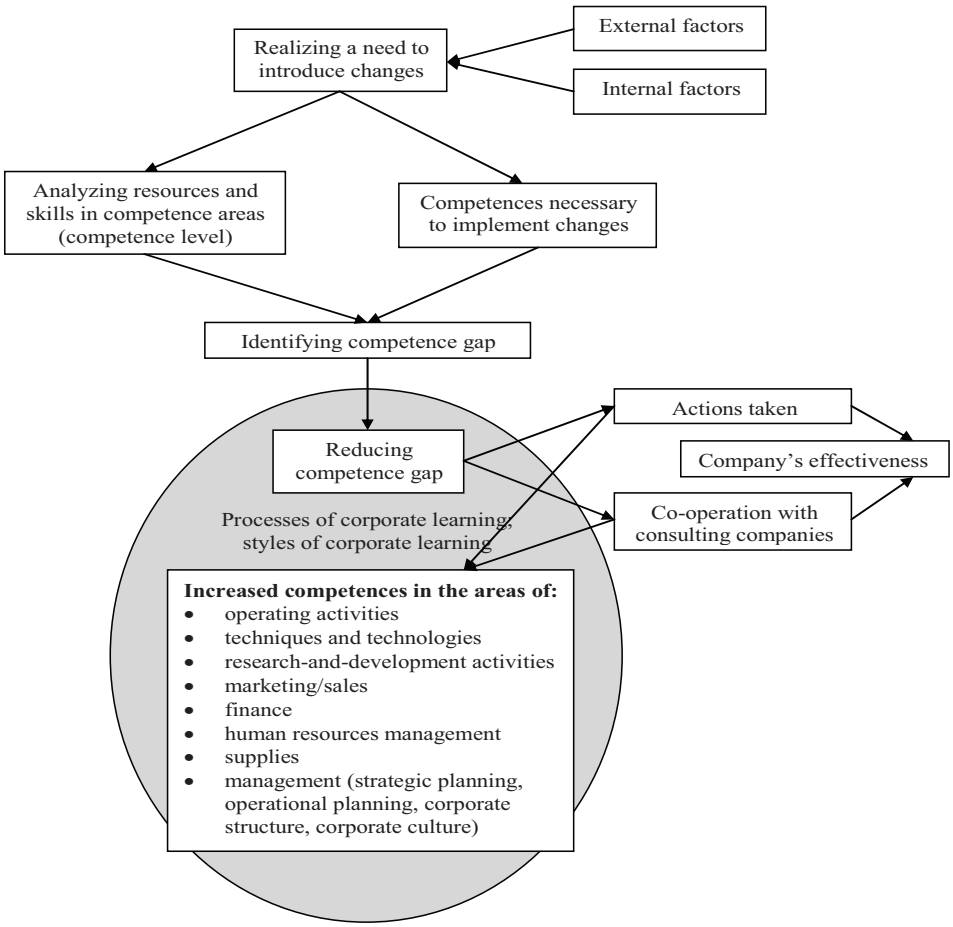

Figure 1. Research model
Source: own work

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

Actions initiated to reduce competence gap and their influence on company's performance

An increase in competences was recorded in the analyzed companies during the studied period (before Poland joined the European Union and in 2008). In the opinion of the respondents competences increased on the average by over 15% (see Table 3) and the highest increase in competences was noted in big enterprises. The increase in small companies was much less significant (8.3%), yet it should be stressed that the representatives of small businesses gave the highest marks to the increase in their companies in both studied periods. Increased competences resulted in better performance in the studied companies.

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 (12), namely:

- acquiring additional tangible assets,
- acquiring additional financial assets,
- acquiring specialists on the job market,
- learning in action
- learning from competitors,
- acquiring competences from business partners,
- training,
- introducing elements of knowledge management,
- building company's own research-and-development potential,
- co-operation with research-and development institutions,
- co-operation with consulting agencies,
- outsourcing.

Among the methods applied to reduce competence gap the analyzed companies (see Table 2), 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 2: Popularity of using the methods of reducing competence gap to improve company's effectiveness

Method used to reduce competence gap	Companies			
	Total	Big	Medium	Small
1. Acquiring additional tangible assets	32,85	29,47	32,07	43,75
2. Acquiring financial assets	31,42	24,74	29,66	53,75

3.	Introducing elements of knowledge management	33,40	36,32	25,86	53,75
4.	Acquiring specialists on the job market	29,64	25,79	26,55	50,00
5.	Acquiring competences from a business partner	18,75	16,84	16,55	31,25
6.	Co-operation with consulting agencies	20,00	20,53	16,21	32,50
7.	Co-operation with research-and-development institutions	11,61	13,68	9,31	15,00
8.	Training	42,69	40,53	38,96	60,00
9.	Building your own research-and-development potential	17,48	11,58	20,34	21,25
10.	Learning in action	39,99	34,21	42,42	45,00
11.	Outsourcing	13,57	12,11	10,35	28,75
12.	Learning from competitors	24,43	19,47	21,72	46,25

Source: own work

Analyzing the individual elements of knowledge spiral according to the concept by I. Nonanka and H. Takeuchi (10), it may be claimed that a relatively highest concentration of knowledge sharing processes can be observed in small businesses (the respondents evaluated the concentration of the occurrence of individual methods of knowledge sharing on a 1 to 5 scale), which has a positive effect on the level of competences in these companies (see Table 3). The socialization process, that is transforming tacit knowledge into tacit knowledge, is most often used in the practice of the analyzed companies, and to the highest degree in small companies. Also externalization, or transforming tacit knowledge into explicit knowledge occurs more intensively in small businesses. The next two elements of the knowledge spiral, combination (turning explicit knowledge into explicit knowledge) and internalization (turning explicit knowledge into tacit knowledge) are most evidently visible in big enterprises. It should be emphasized that big companies observed the highest increase in their competence potential and, according to the respondents, the effectiveness of their functioning increased significantly.

Table 3. Increase in competences and the methods of knowledge sharing

Specification	**Companies**			
	Total	**Big**	**Medium**	**Small**
Competence level before joining the EU	3,35	3,43	3,19	3,79
Competence level at present	3,87	4	3,71	4,11
Competence increase	0,51	0,57	0,52	0,31
Competence increase	15,30%	16,70%	16,30%	8,30%
Socialization processes	3,98	3,79	4,05	4,19
Externalization processes	3,25	3,37	3,09	3,56
Combination processes	3,5	3,86	3,18	3,75
Internalization processes	3,51	3,76	3,33	3,56

Source: own work

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 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;
- Creating a bank of information which should be used while taking decisions and constant improvement of the organization's effectiveness.

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DIMENSIONS OF TQM: RELATION TO ROLE AMBIGUITY

Pei-Lee Teh, Faculty of Management, Multimedia University, Malaysia
plteh@mmu.edu.my
Chen-Chen Yong, Faculty of Management, Multimedia University, Malaysia
ccyong@mmu.edu.my
Veeri Chettiar Arumugam Faculty of Management, Multimedia University, Malaysia
arumugam@mmu.edu.my
[4]Keng-Boon Ooi, Faculty of Business and Finance, University Tunku Abdul Rahman, Malaysia
ooikengboon@gmail.com

ABSTRACT

This study examines the extent to which Total Quality Management (TQM) practices (i.e. leadership, strategic planning, customer focus, information analysis, human resource focus and process management) are associated with role ambiguity experienced by employees. The empirical data are collected from 392 employees from both manufacturing and service firms in Malaysia. To our knowledge, this is the first empirical study of a theoretically based model which integrates the different dimensions of TQM with role ambiguity. Using structural equation modelling, leadership and process management are found to have negative relationships with role ambiguity. Human resource focus is found to have a positive relationship with role ambiguity. The findings indicate that the firms should focus on the influence of leadership and enhancement of the process management in order to reduce the unpleasant effect of role ambiguity experienced by employees. Additional efforts are needed to reduce the pressure of human resource focus on role ambiguity. From a managerial perspective, the proposed research model is useful for practical usage by organisational administrators and managers to attain a better understanding of the different dimensions of TQM in relation to role ambiguity of employees.

Keywords: Total Quality Management, Role Ambiguity, Malaysia, Structural Equation Modelling.

INTRODUCTION

The "quality revolution" is widely recognized as a new philosophy of management practice (85). Effective implementation of Quality Management (QM) or Total Quality Management (TQM) is helpful for an organization to achieve higher levels of competitiveness and business excellence (84). Much of the popular literature on TQM subscribes to the core values that TQM is a management philosophy and a holistic approach based on three principles (i.e. customer orientation, process orientation and continuous improvement) (97).

For a company to realize the value of TQM practices, it must have internal organizational structures/factors that are able to support the TQM implementation (92). Organization structure provides a basis within which the organization functions and it is known to affect employees' behaviour (15). French *et al.* (28) suggested the changes in organizational structures, policies and procedures (e.g., increase the flexibility of role structures, policies and procedures) as strategies for managing job stress. However, Pearce (65) emphasized that certain organizational structural characteristics can cause individuals to experience role

ambiguity. Role ambiguity, or lack of role clarity, results from insufficient information and/or authority with which the employee can do their jobs (1). Because increased levels of role ambiguity are dysfunctional to job outcomes (73), there is a need to provide industrial/organizational (I/O) administrators and managers with some ideas for applying different dimensions of TQM practices in reducing role ambiguity – a domain of research and application which is within the I/O professional but which they have largely ignored.

Although TQM literature is peppered with studies concerning the impact of TQM on organizational and financial performance (e.g. 38, 70, 76) and impact of TQM on customer satisfaction (e.g. 89, 98), studies which examine the relationship between individual TQM practices and employees' role ambiguity have been neglected. Therefore, this study contributes to the TQM literature by addressing an underexplored question at the nexus between TQM and role ambiguity as well as bridging the existing research gap between TQM and organizational psychology research. Similarly, this study would be of interest to organizational administrators and managers because the employees' role ambiguity is an important element for determining the success or otherwise of a TQM program.

In the next section, the literature review on TQM and role ambiguity is presented. This section includes the development of research hypotheses and a research model. Section 3 describes the research method and data collected from 392 employees in TQM-based organizations to test these hypotheses. Section 4 presents the statistical analyses. Section 5 discusses the results of the findings. Section 6 presents the research limitations and future research. Section 7 discusses the implications of the research findings and concluding remarks.

LITERATURE REVIEW AND RESEARCH MODEL

TQM Practices

TQM is an integrated management philosophy focused on continuous improvement of product and process quality through a holistic approach that integrates technical systems with social-cultural systems within a company to attain customer satisfaction (46). Numerous researchers have adopted the Malcolm Baldrige National Quality Award (MBNQA) framework as the fundamental model of TQM (13). The MBNQA not only codifies the ideology of quality management in an understandable language but also provides organizations with a comprehensive framework for evaluating their organizational progress with a new management paradigm such as increased customer satisfaction and employee involvement (30).

The MBNQA criteria are built upon six dimensions namely, leadership, strategic planning, customer focus, information and analysis, people management as well as process management (76). Many international awards such as the Brazilian National Quality Award, Egyptian Quality Award, European Quality Award, Japanese Quality Award and the Mexican National Quality Award are highly influenced by the MBNQA (26). Because several international awards have been modeled after the MBNQA, the recognition of "MBNQA clones" confirms its versatility and strength of the award globally (90). Therefore, the TQM constructs of the present study have chosen to follow the MBNQA criteria, namely leadership, strategic planning, customer focus, information analysis, human resource focus and process management.

Role Ambiguity

There has been extensive literature on role ambiguity after Kahn *et al.* (48) published the theory of organizational stress (8). Role ambiguity has been specifically receiving much attention from organizational behavior researchers (65) and it is an important factor in employee morale (91). Following Singh and Rhoads (80), perceived role ambiguity is a multidimensional, multifaceted evaluation concerning insufficient salient information required to perform a role. This evaluation consists of ambiguity about role definition, responsibilities, expectations, tasks and behaviors in single or multiple facets of the task environment (80).

Role ambiguity occurs when an individual is uncertain about the role expectations and has no idea on how to enact the role (17, 63, 73, 96). For example, Information Systems (IS) managers experience role ambiguity when dealing with conflicting, unclear and varying expectations from many users, and having to act with uncertain authority (94). From the perspective of a salesperson, Rhoads *et al.* (73) suggested that a salesperson often faces ambiguity regarding objections (e.g., how to deal with customers' objections) and presentation (e.g., product benefits that should be presented to the customers). Role ambiguity may also arise when there are discrepancies in value orientations (e.g., financial value orientation and customer value orientation) between the organization and the salesperson (24).

Prior studies (e.g., 7, 17, 43, 49, 73) have found that role ambiguity result in unfavorable psychological (e.g. job satisfaction) and behavioral outcomes (e.g., job performance). In the present study, we aim to examine role ambiguity from a different aspect. We seek to understand the effects of different TQM practices on employees' role ambiguity.

The Hypothesized Relationship between Leadership and Role Ambiguity

Leadership is conceptualized in terms of behavioral actions which demonstrate senior management personal involvement in the process of quality improvement efforts, acceptance of responsibility for quality performance, visibility in creating and maintaining a quality excellence work environment and sharing the vision and quality goals with the organization (71). Following Kerr *et al.* (52), two leadership behavior dimensions have been identified (i.e. leader-initiating structure and leadership consideration). Within the context of a call center, leader-initiating structure refers to the way in which a supervisor guides employees, gives explanations, monitors calls, and inspires employees to obtain higher achievement (75). Leadership consideration is oriented toward building good interpersonal relationship with employees (75). These two leader behaviors are equally correlated with role ambiguity (42).

The more often managers engage in unambiguous communication about organizational goals, strategies and objectives, the lower employees' role ambiguity will be (99). For example, Michaels *et al.* (56) have found supportive leader behaviors were associated with lower levels of role ambiguity. Dubinsky *et al.* (19) reported that leadership (i.e. leader-initiating structure) was found to be negatively related to role ambiguity while leadership consideration was not significantly related to role ambiguity. Johnston *et al.* (45) confirmed that the higher levels of leadership role clarification result in lower role ambiguity. These empirical results thus lead to the following hypothesis:

H1: The greater emphasis on leadership will lead to lower levels of role ambiguity among employees.

The Hypothesized Relationship between Strategic Planning and Role Ambiguity

Strategic planning is the systematic process of establishing the organization's goals and objectives for at least three years and developing the strategies that manage the acquisition and use of resources to realize these objectives (53). However, it is difficult to develop a systematic strategic planning process in an era of increased volatility of the business world (33).

Strategic planning often involves complex interactions between departments with different interests and different objectives. The multiple levels of organization hierarchy make the harnessing of strategic planning more difficult. As a result, employees are likely to experience higher levels of role ambiguity when they are assigned to implement strategy plans developed from the weakly coordinated decisions of multiple departments. Role ambiguity arises because the priorities, expectations and evaluation criteria are unclear to the employees (69). As such, the following hypothesis is proposed:

H2: The greater emphasis on strategic planning will lead to higher levels of role ambiguity among employees.

The Hypothesized Relationship between Customer Focus and Role Ambiguity

Customer focus is an essential component of TQM because firms could outperform their competitors by satisfying customers' needs and anticipating customers' increasing demands (88). This customer value orientation has a significant impact on role ambiguity (24). A study by Flaherty *et al.* (24) found that customer value orientation discrepancy increased role ambiguity. There is another aspect of customer focus, that is, the present role of service recovery management which is important to the operations manager and organizational success (57).

Service recovery entails those actions concerning problem solving, managing negative attitudes of dissatisfied customers and retaining these customers (57). However, varying customer demands and high levels of human involvement make service delivery process more difficult (57), thereby resulting in higher levels of role ambiguity among employees. For example, given the role to facilitate service recovery, frontline service employees frequently do not know whether they should grant offers of compensation on top of service recovery or only adhere to organization policy to restore service without making extra compensation (86). In this context, it is hypothesized that:

H3: The greater emphasis on customer focus will lead to higher levels of role ambiguity among employees.

The Hypothesized Relationship between Information Analysis and Role Ambiguity

The TQM implementation of an organization is considered ineffective if there is inadequate dissemination of general information (88). Quality improvement efforts often involve formal data collection and analysis (41). At a conceptual level, information and analysis refer to the

availability, timeliness and usage of quality-related data at every hierarchal level in the firms (71).

Essentially, the status and performance of materials, processes, departments, divisions, teams and individuals can be monitored through data collection and quality measurement systems (32). As a result, employees are less likely to experience role ambiguity because they know how to perform their job with the availability of information required. Therefore, we propose the following hypothesis:

H4: The greater emphasis on information analysis will lead to lower levels of role ambiguity among employees.

The Hypothesized Relationship between Human Resource Focus and Role Ambiguity

Following Ahire and O'Shaughnessy (2), quality-oriented human resource management applies different approaches (e.g., empowering employees; providing necessary infrastructure to facilitate employee participation) to create a quality management environment. Furthermore, the consistency between human resource performance evaluation criteria and TQM principles are used as a proxy for developing employees' positive attitudes towards effective TQM program (83).

However, the management of TQM-based firms often need to modify the performance evaluation criteria, rewards, compensation, promotions to be compatible with the current market practice. Therefore, employees are likely to experience role ambiguity when they are uncertain of the changing criteria. Churchill *et al.* (14) further reported a salesperson experiences role ambiguity and feels pessimistic about his chances for promotion or a pay raise when he has uncertainty about what is expected of him and how his performance will be assessed. In addition to this, a successful TQM program often involves empowerment, which enhances employees' commitment and promotes a change of employees' perception of roles and values (41). However, Wetzels *et al.* (95) asserted that empowerment may raise uncertainty because fewer approved standards or procedures are given as guidelines for employees. As a result, the practice of human resource focus (e.g., empowerment and performance evaluation criteria) is likely to increase employees' role ambiguity. The following hypothesis is proposed:

H5: The greater emphasis on human resource focus will lead to higher levels of role ambiguity among employees.

The Hypothesized Relationship between Process Management and Role Ambiguity

Process management involves planning and administering the organizational activities to achieve a high level of performance in a process (20). The core activities underlying process management are sets of interlinked processes and formalized organizational structures. Following Ravichandran and Rai (72), formalization of analysis and design methods, formalization of reusability, fact-based management and process control are important to a successful management of the development process.

Because formalization helps to clarify roles, it has the tendency to reduce role ambiguity of employees (1, 42). A study by Nicholson and Goh (60) found a negative association between

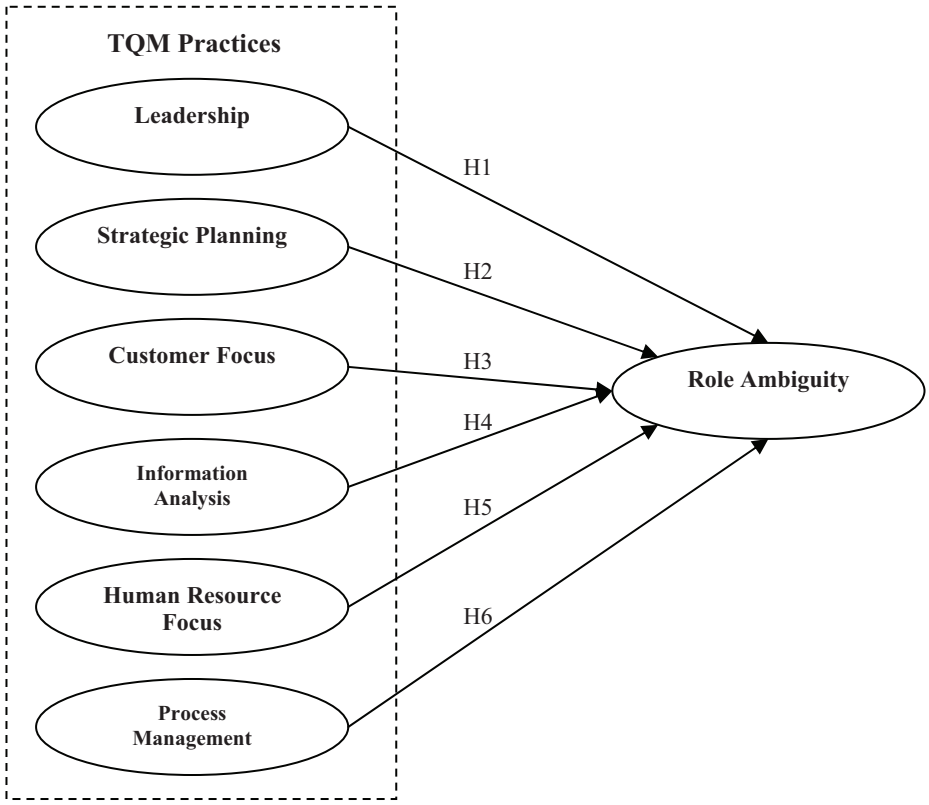
formalization and role ambiguity of the production workers. This is further supported by Singh *et al.* (81), in which, clear and communicated organizational practices will lower the levels of role ambiguity. Johnson *et al.* (44) also reported that formalization is negatively related to role ambiguity. On the basis of the above studies, the following hypothesis is proposed:

H6: The greater emphasis on process management will lead to lower levels of role ambiguity among employees.

Research Model

A research model has been developed to examine the relationship between TQM practices and role ambiguity (see Figure 1). The TQM practices are analyzed as independent variables and role ambiguity is analyzed as dependent variable.

Figure 1: Research Model



RESEARCH METHODOLOGY

Measures

Independent Variables: TQM practices
In the present study, the scales of TQM practices used are an adaptation of the instrument developed by Prajogo *et al.* (66), Prajogo and Sohal (67), Samson and Terziovski (76), Sohail and Teo (82), as well as, Zhang *et al.* (100). The selection of the scales is strongly supported by two reasons. First, previous studies (e.g., 76, 100) have demonstrated that these scales have considerable sensitivity and validity. Second, these scales are designed to capture the

criteria of the MBNQA that have been determined as the basis of the present study. The six scales of TQM practices (i.e. leadership, strategic planning, customer focus, information analysis, human resource focus and process management) are measured using 42 items. Sample items in the present study include the following items: "Top management strongly encourages employee involvement in quality management and improvement activities" (*leadership*), "Our organization has a written statement of strategy covering all business operations which is clearly articulated and agreed by our senior manager" (*strategic planning*), "Our organization treats quality-related customer complaints with top priority" (*customer focus*), "Our organization's compensations system encourages team and individual contributions" (*human resource focus*), "Our organization has the ability to monitor all production/service processes to improve quality" (*process management*) and "Our organization has knowledge, availability, access and collection of data" (*information analysis*). All TQM variables are measured using 5-point Likert-type scales anchored from 1 = strongly disagree to 5 = strongly agree.

Dependent Variable: Role Ambiguity
Role ambiguity is measured using nine items from scales developed by Rizzo *et al.* (74). The items of this scale, to some extent, capture global perceptions of role ambiguity, in terms of an employee's feelings and perceptions about the job role and can be utilized with any job (18). Furthermore, the psychometric properties of this scale have been favourably evaluated and reported by House *et al.* (39) and Schuler *et al.* (78). The selection of this scale is also supported by its extensive use in the industrial and organizational studies (e.g., 1, 9, 29, 31, 45, 49, 51, 59, 60, 81, 87). In this present study, the items are scored on a five-point rating scale with 1 = strongly disagree, and 5 = strongly agree (e.g., "I feel certain about how much authority I have").

Sample and Procedures

The unit of analysis for the present study is the individual. These individuals are the full-time salaried employees of ISO 9001:2000 certified firms in Malaysia. The employees of these firms were chosen because ISO 9000 registration is significantly related to quality management practices (71). ISO 9000 registered organizations exhibit higher levels of quality leadership, strategic planning, customer focus, information analysis, human resource focus, process management which underlie the MBNQA model (71). This study selects ISO certified companies from the Federation of Malaysian Manufacturers (FMM) directory (23) as the population frame. Because FMM is the largest economic institution in Malaysia representing more than 2000 manufacturing and industrial service companies of varying sizes (22, 23), the FMM directory is commonly used as a population frame for the manufacturing and service organizations in Malaysia (e.g., 3, 12). Furthermore, only 47% of the 2135 organizations have been awarded ISO certification under the strict system that governs full membership of FMM (22).

A field study using a survey questionnaire is selected as the most appropriate design for this study. All respondents are promised anonymity in order to reduce the social desirability of responses (10). Of the 650 questionnaires which are distributed, 453 are returned. Because the nature of the job functions of the engineering employees is such that they do not directly interact with customers, the authors in this paper have removed engineering employees from the sample. Therefore, 392 respondents are used in the analysis, yielding a response rate of 60.31%. The characteristics of the respondents are shown in Table 1.

Table 1: Profiles of the Survey Respondents

Profile	Percentage (%)	Profile	Percentage (%)
Gender		***Marital Status***	
Female	53%	Single	55%
Male	47%	Married	45%
Age		***Length of Service***	
Below 21 years old	1%	More than six month but less than 1 year	21%
21-25 years old	25%	1–2 years	25%
26-30 years old	33%	3-5 years	20%
31-35 years old	17%	6-10 years	15%
36-40 years old	11%	11-20 years	15%
41 or above	13%	Above 20 years	4%
Qualifications		***Type of Work***	
No college degree	10%	Administration	37%
Diploma	15%	Production	12%
Bachelor degree/ Professional qualification	59%	Computer and information technology	28%
Master or higher degree	16%	Sales and marketing	23%

DATAANALYSIS

Scale Validation

Prior to testing the confirmatory factor analysis (CFA) and structural equation modelling (SEM), the negatively worded items from the role ambiguity scale are reversed, the data are analyzed using Statistical Package for the Social Sciences (SPSS) 11.5 and Analysis of Moment Structures (AMOS) 16.0 (5). A two-stage approach is used to model the data (4). The first stage incorporates the development of measurement models using CFA to achieve the best fitting group of items to represent each scale while the second stage involves the specification of the structural model.

Because TQM practices and role ambiguity are not directly observable, this study performs maximum likelihood (ML) CFA using AMOS 16.0 to test the measurement models with indicator variables for these latent constructs. A violation of the assumption of multivariate normality can invalidate the test statistics (40) and according to Hair *et al.* (36), the skewness and kurtosis values should not fall outside the range of -1 to +1. In this present study, the measures of skewness and kurtosis do not exceed the absolute value of ±1 and strongly indicate that there are no violations of assumption of normality.

The measurement model could be improved by removing the items of constructs (e.g., items LD1, LD2 or LD3 of leadership construct). A combination of criteria based on the results of CFA (i.e. cross-loading items, factor loadings 0.50 or lower, chi-square value reductions) was used to identify and remove a total of four items, namely leadership (LD1), process management (PM4) and role ambiguity (RA5 and RA8) from the final measurement model. No items associated with the constructs of strategic planning, customer focus, information analysis and human resource focus have been deleted. The internal consistency reliability of the questionnaires is assessed using Cronbach's Alpha measurements. After removing the three items mentioned above, the scales consist of satisfactory reliability coefficients ranging

from 0.788 to 0.904 (see Table 2). The values are greater than the modest reliability value of 0.7 as suggested by Nunnally and Bernstein (62).

Table 2: Reliability and Validity of TQM and Role Ambiguity

Dimension	Constructs	No. of Items	Retained Items	Cronbach's Alpha	Composite Reliability
TQM	Leadership	7	6	0.861	0.863
	Strategic Planning	7	7	0.873	0.871
	Customer Focus	7	7	0.852	0.842
	Information Analysis	7	7	0.904	0.902
	Human Resource Focus	7	7	0.899	0.897
	Process Management	7	6	0.837	0.828
Role Ambiguity	Role Ambiguity	9	7	0.788	0.781

Notes: Items were deleted due to lack of item reliability or low factor loadings.

Composite reliability is another indicator of measurement model fit. Bagozzi and Yi (6: 80) asserted that composite reliability is defined using the following formula:

$$\text{Composite reliability} = \frac{(\sum \lambda_i)^2 \text{ var } (T)}{(\sum \lambda_i)^2 \text{ var } (T) + \sum \theta_{ii}} \quad (1)$$

The numerator of Equation 1 for computing composite reliability is equal to the square of the summation of the factor loadings. The denominator of Equation 1 is equal to the square of the summation of the factor loadings plus the summation of the variances due to random measurement error for each loading. The interpretation of this coefficient is important because it measures the actual factor loadings instead of presuming that every item is equally weighted in the composite load determination (11). The composite reliabilities of all latent constructs in this study are calculated using Equation 1 and the results are presented in Table 2. As shown, the composite reliabilities of all latent constructs surpass the desirable threshold of 0.60 suggested by Bagozzi and Yi (6).

Discriminant validity of a measure is the "degree to which the measure is not similar to (diverges from) other measures that it theoretically should not be similar to" (88: 397). Discriminant validity is validated when a measure does not correlate highly with other measures from which it is supposed to differ (88). Based on Hair *et al.* (36), the *r*-value between each pair of independent variables in Pearson's correlation should not greater than 0.90 that may indicate the presence of multicollinearity. Table 3 shows that the correlation between constructs ranged from -0.476 to 0.770. In this study, the highest value of correlation is 0.770 (process management with human resource focus) which is less than 0.90. Therefore, these results ensure the discriminant validity of the measures, and validate that there is no multicollinearity problem among the constructs.

Table 3: Correlations Matrix

Construct	LD	SP	CF	IA	HR	PM	RA
LD	**1.000**						
SP	0.748**	**1.000**					
CF	0.520**	0.720**	**1.000**				
IA	0.584**	0.697**	0.667**	**1.000**			
HR	0.638**	0.703**	0.598**	0.689**	**1.000**		
PM	0.651**	0.754**	0.654**	0.753**	0.770**	**1.000**	
RA	-0.419**	-0.456**	-0.356**	-0.437**	-0.380**	-0.476**	**1.000**

Notes: *N* = 392; ** denotes correlations significant at $p < 0.01$; LD = Leadership; SP = Strategic planning; CF = Customer focus; IA = Information Analysis; HR = Human Resource Focus; PM = Process management; RA = Role Ambiguity.

Measurement Model

Multiple fit indices are taken into account in assessing the goodness of fit of both measurement and structural model. These fit indices are namely, (1) Absolute fit indices: goodness-of-fit (GFI) index and adjusted goodness-of-fit (AGFI) index; (2) Incremental fit indices: comparative fit index (CFI), normed fit index (NFI) and non-normed fit index (NNFI); (3) Root mean square error of approximation (RMSEA); and (4) the chi square (χ^2) - test statistics/ degrees of freedom (*d.f.*) ratio. Following Hu and Bentler (40), absolute-fit indices evaluate the goodness of a *priori* model to reproduce the sample data, whereas incremental fit indices measure the proportionate improvement in fit by measuring a target model against a nested baseline model. Therefore, the values of incremental fit indices are suggested as plausible measures of model fit. According to Arbuckle (5), the Bentler-Bonett non-normed fit index (NNFI) is known as Tucker-Lewis index (TLI). Because TLI is independent of sample size, TLI is widely used compared with GFI and AGFI which are positively associated with sample size (21, 55). Furthermore, CFI is used as one of the preferred indicator for evaluating model fit because CFI takes into account the model misspecification and it is independent of sample size (21, 25). Since RMSEA is an index used to assess the residuals and it is independent of sample size (79), RMSEA is taken as another well suited criterion to assess the models' goodness of fit. Value for the RMSEA below 0.05 exhibits an excellent fit to data (40, 58). As shown in Table 4, there is a considerable fit for the model because all the model-fit indices (i.e. $\chi^2/d.f.$ = 1.626, GFI = 0.875; AGFI = 0.855; NFI = 0.884; NNFI = 0.946; CFI = 0.951; and RMSEA = 0.040) of the measurement model exceeds the acceptance levels reported by the past studies (11, 27, 40, 47, 54, 64).

Table 4: Multiple Fit Indices of the CFA Measurement and Structural Model

Model-fit-index	Desirable range	Measurement model	Structural model
χ^2 - test statistics/degrees of freedom	≤ 3 [a,e]	1.626	1.580
Goodness of fit index (GFI)	≥ 0.80 [b,c,e]	0.875	0.857
Adjusted Goodness-of-fit index (AGFI)	≥ 0.80 [a,b]	0.855	0.837
Normed fit index (NFI)	≥ 0.80 [b]	0.884	0.859
Non-normed fit index (NNFI)	≥ 0.90 [a,e]	0.946	0.937
Comparative fit index (CFI)	≥ 0.90 [a,e]	0.951	0.943
Root mean square error of approximation (RMSEA)	≤ 0.05 [d]	0.040	0.039

Notes: [a]Chau and Hu (11); [b]Forza and Filippini (27); [c]Greenspoon and Saklofske (34); [d]Hu and Bentler (40); [e]Jun *et al.* (47).

Structural Model

Table 4 also shows that the structural model fits the data, as all the model-fit indices (i.e. $\chi^2/d.f.$ = 1.580, GFI = 0.857; AGFI = 0.837; NFI = 0.859; NNFI = 0.937; CFI = 0.943; and RMSEA = 0.039) exceed the general acceptance levels.

As shown in Table 5, the hypothesis testing results reveals that process management (path coefficient = -0.385, $p < 0.05$) and leadership (path coefficient = -0.187, $p < 0.05$) and are found to have a significant and negative relationship with role ambiguity. Human resource focus (path coefficient = 0.169, $p < 0.05$) appears to have a significant and positive relationship with role ambiguity. Therefore, the hypotheses H1, H5 and H6 are empirically supported. However, there is insufficient evidence to validate H2, H3 and H4 because strategic planning (path coefficient = 0.162, $p > 0.10$), customer focus (path coefficient = -

0.037, $p > 0.10$), and information analysis (path coefficient = -0.060, $p > 0.10$) are not significantly related to role ambiguity.

Table 5: Hypothesis Testing Results

Hypothesised Path	Standard estimate	Critical value	*p*-value
H1 Leadership → Role Ambiguity	-0.187 (0.075)	-2.484	0.013*
H2 Strategic Planning → Role Ambiguity	0.162 (0.145)	1.113	0.266
H3 Customer Focus → Role Ambiguity	-0.037 (0.076)	-0.488	0.626
H4 Information Analysis → Role Ambiguity	-0.060 (0.068)	-0.881	0.378
H5 Human Resource Focus → Role Ambiguity	0.169 (0.068)	2.495	0.013*
H6 Process Management → Role Ambiguity	-0.385 (0.154)	-2.503	0.012*

Notes: * denotes value significant at $p < 0.05$; Standard errors are shown in parentheses.

DISCUSSION

Findings from the present study contribute new insights into the relationships between the different dimensions of TQM practices and role ambiguity. It is found that leadership and process management have negative relationships with role ambiguity. Human resource focus is reported to have a positive relationship with role ambiguity. The significantly higher coefficient for process management compared with human resource focus suggests that process management is more effective in reducing role ambiguity experienced by employees.

The findings of this study show that process management is significantly negative related to employees' role ambiguity. This result is consistent with the prior studies (e.g., 44, 60, 81), in which role ambiguity was found to have an inverse relationship with process management (e.g., formalization). This finding indicates that formalized process management is needed in the work environment to reduce ambiguity in work roles by clarifying and defining job responsibilities.

The hypothesized negative relationship between leadership and role ambiguity is statistically significant. This result is supported by Michaels *et al.* (56), Dubinsky *et al.* (19) and Johnston *et al.* (45), in which a negative correlation between leadership and role ambiguity was reported. The result indicates that leadership is effective in reducing role ambiguity experienced by employees. The management staff who share the vision, model the vision, support employee efforts and inspire risk taking would help to reduce employees' role ambiguity (61).

Human resource focus is found to be positively related to role ambiguity. This result is consistent with the finding by Hartline and Ferrell (37) which reported a positive relationship between human resource focus (e.g., empowerment) and role ambiguity. This result implies that human resource focus is significantly related to greater level of employees' role ambiguity. The human resource function should recognize that it serves multiple constituencies including top management and all the organizational members. Therefore, the human resource function must realize whether its human resource practices (e.g., empowerment, performance evaluation criteria, rewards, compensation, promotions) are getting into every employee, when top management may be more concerned with rapid action and outcomes. This is because employees are often left to fend for themselves in determining what is expected of them in the performance of their organizational roles (50).

The present study found no relationship between strategic planning and role ambiguity. The diversity of the sample in this study may be to some extent responsible for this insignificant

result. This can be explained by the fact that strategic planning is a structured process of setting the short and long term goals (68) among the top management team (16), and not all employees are directly engaged in the strategic planning. Because the sample in this study comprises about 59% of the respondents (i.e. respondents who are aged below 30 years old) who are apparently not directly involved in the strategic planning as top management, these respondents are unlikely to experience role ambiguity in relation to strategic planning. Therefore, the response of these 59% of the respondents will affect the overall result of the survey on strategic planning.

Customer focus is reported to have insignificant relationship to role ambiguity. This result is supported by the notion made by Schermerhorn and Bond (77), in which Malaysian work teams generally show high levels of collectivism and possesses great respect for authority in supervisor-subordinate relationships. A basic attribute of collectivist cultures is that individuals are "typically induced to subordinate their personal needs to the needs of one or (at most) a few collectives, which are usually stable in-groups (e.g., family, tribe, company, etc.)". (93: 75) Therefore, employees in Malaysia are unlikely to experience role ambiguity concerning customer focus because they act according to their superior's instructions and are averse to act against authority to meet the uncertain customer expectations and demands.

Information analysis is observed to be insignificant to role ambiguity. Following Greller and Herold (35), there are two types of information, namely, referent information (e.g., information which tells the employees what is required of them to function effectively on the job) and appraisal information (e.g., information which tells the employees if they are functioning successfully on the job). The result of this study implies that the practice of information analysis in the survey firms may not emphasize the area of referent and appraisal information which are helpful to reduce role ambiguity experienced by the employees.

RESEARCH LIMITATIONS AND FUTURE RESEARCH

Several limitations of the present study should be taken into consideration. First, the present study uses cross-sectional data, thereby limiting the strength of causal inferences. Longitudinal studies are needed for interpretations of causality in the linkages between TQM practices and role ambiguity. Second, the present study is undertaken in the TQM-oriented organizations in Malaysia and thus generalizing the results may be difficult. Future studies should collect data from other geographical regions to provide further empirical support for the present results. Third, the proposed research model examines the impact of individual TQM practices on employees' role ambiguity. Future research should attempt to measure the moderating effects of individual differences (e.g., need for achievement, need for independence etc) on employees' responses to role ambiguity.

CONCLUSIONS AND IMPLICATIONS

This study offers a novel conceptualization of the relationship between the multi-dimensionality of TQM practices and role ambiguity in TQM-oriented organizations, providing additional clarity about underlying relationships of variables. This study shows that constructs from TQM practices can relate to role ambiguity. Knowledge of these relationships yields opportunities for industrial practitioners in the TQM-based firms to manage role ambiguity experienced by the employees.

Theoretically, the present study offers an integrative research model of six dimensions of TQM practices linking with role ambiguity. This theoretical contribution is valuable, given that the present research model differs from other studies by examining the individual influences of TQM practices on employees' role ambiguity. Practically, the present research model is useful for organizational administrators and managers to assess which dimensions of TQM practices would be effective in reducing role ambiguity experienced by employees. Following the results of the present study, managers should facilitate enhancement of process management and encourage higher involvement of quality-oriented leadership to reduce the perceived role ambiguity on the job. Furthermore, human resource personnel should provide employees with clear role expectations and job behaviours that are required to achieve promotions or rewards. Regular periodic evaluations of the employees may assist the human resource personnel to measure the levels of role ambiguity.

Although the implementation of TQM practices has improved the organizational performance, the implications of such practices on employee wellbeing, in particular role ambiguity are not to be overlooked. Role ambiguity may lead employees to be less committed to their firms and eventually results in a propensity to leave the firm. Therefore, it is envisaged that the present study will provide the necessary impetus for more efficient and effective TQM implementation that facilitate reduced levels of role ambiguity experienced by the employees.

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AN APPROACH FOR ELIMINATING REDUNDANCY IN VIRTUAL ENTERPRISING

Reggie Davidrajuh, University of Stavanger, Norway
reggie.davidrajuh@uis.no

Zbigniew Pastuszak, Maria Curie-Sklodowska University, Poland
z.pastuszak@umcs.lublin.pl

ABSTRACT

In virtual enterprise in which a number of collaborating enterprises join together to manufacture and sell a class of product for a time-limited period, the existence of redundancy is a serious problem. This paper proposes a new approach for detection of and elimination of redundancy in virtual enterprises; the proposed approach is based on workflow and uses Petri net for modeling and simulation of workflows. This paper also presents a working example as a proof of concept.

Keywords: Virtual enterprise, collaborative work, workflow, redundancy, optimization

1. INTRODUCTION

The research problem discussed in this paper is the existence of redundancy in virtual enterprises. Virtual enterprise means a nucleus enterprise (or main assembler) joins with a number of collaborating enterprises (supply and distribution enterprises, transporting agents), to manufacture and sell a class of product with the characteristics such as qualitative, agility, and leanness, to achieve maximum customer satisfaction. When market requirements are changed, a new class of products or an improved version of the product should be turned out to meet the new market requirements. In this case, the nucleus enterprise may seek for a new combination of collaborating enterprises that are more suitable to manufacture the new class of products; thus the main aspect of virtual enterprise is dynamic logic of organization and reorganization of collaboration (Badir et al., 2005).
Formation of a virtual enterprise is rather quick, as market opportunities for which the virtual enterprise was is being formed are time-limited. Due to the time constraint and due to the independency of collaborating enterprises, when forming a virtual enterprise, collaborating enterprises are mainly concerned about division of labor and responsibilities for production, distribution, and sales of products; there isn't much time left for any one of the collaborating enterprise to see what and how the other enterprise is going to perform its operations. Hence, there will be redundancy as two or more enterprises may be unknowingly doing the same operations, job, or functions.

2. LITERATURE REVIEW ON ELIMINATING REDUNDANCY

The problem of redundancy elimination in the area of computer science is quite popular. One of the very first works concerning this problem is Ford's and Fulkerson's book on flows and networks (Ford & Fulkerson, 1962) and Morel's and Renvoise's paper on optimization and suppression of partial redundancies (Morel & Renvoise, 1979). Many authors describe the problem of redundancy from the software preparation and language optimization point of view. They are using generally the partial redundancy elimination (PRE) and/or global value numbering (GVN). PRE is a program transformation that identifies and eliminates expressions that are redundant on at least one execution paths. GVN is a program analysis and transformation that identifies operations that compute the same value and eliminates operations that are redundant (i.e. VanDrunen & Hosking, 2004; Xue & Knopp, 2006). In general most of authors focus on computer network synchronization (Awerbuch, 1985), efficient maximum-flow algorithms (A.V. Goldberg, R.E. Tarjan, 1988) or real-time optimization approach (i.e. Nagy & Akl, 2003).
But the problem of redundancy elimination in virtual enterprises is a green field still. As a matter of fact we can find many works concerning web-based forms of cooperation, but they generally focus on different aspects of technical optimization of work (i.e. Flake et al., 2002; Knoop & Mehofer, 2002; Phillips, 1993; Scholz et al., 2004 or Soon et al., 2004). If we are looking for papers describing the net (virtual) enterprises construction and insiders cooperation, we can find many works concerning for example: analytical network process (ANP) methodology (Sarkis et al., 2007), generic business process clarification (Sackett et al., 2003), process quality management (Lau et al., 2003), collaborative supply chain development (Davidrajuh, 2003), or exchangeable and sharable information environment for a virtual enterprise (Zhao et al., 1999). There is no papers concerning redundancy elimination problem in virtual enterprises that are analyzed in the business areas such as functions, and processes.
We are sure that a virtual enterprise construction process is consisting of many stages. Some of them need to connect different activities of the same business areas of different partners. So we get the situation of functions and processes redundancy and we have to eliminate it. In the next part of the paper we have proposed a new approach to eliminate the redundancy problem in virtual enterprising using Petri Nets.

3. ELIMINATING REDUNDANCY: A NEW APPROACH

In this paper, we propose a new approach for eliminating redundancy in virtual enterprising. Our approach is an iterative approach in which simulations are done iteratively until simulations results converge resulting in an optimal design.

Our approach consists of the following four stages (Figure-1):

1. Initial global workflow
2. Partitioning global workflow into local workflow modules
3. Optimizing local workflows
4. Joining local workflows and making global optimization

Stage-1: Starting with a crude global workflow: The collaborating enterprises agree on a virtual-enterprise wide global workflow; the global workflow clearly identifies main functional blocks (or domains; e.g. manufacturing, sales, suppliers, distributors, etc.) of the

virtual enterprise and also the interfaces between the functional blocks. The global workflow serves as an outline (or contract) between these collaborative enterprises. Though the global workflow clearly identifies both functional blocks and the interfaces between them, the functional blocks are crude and lack details.

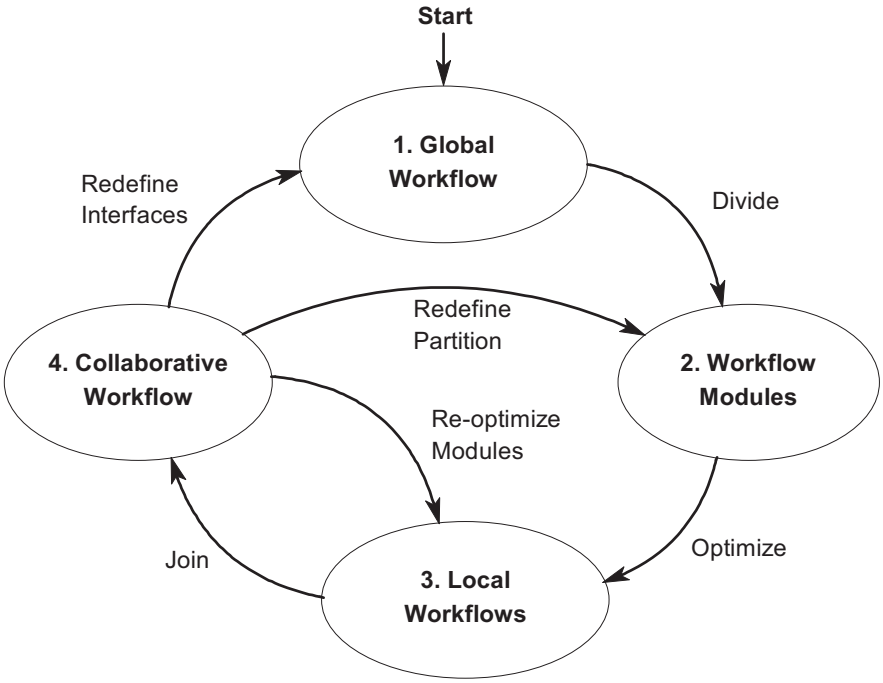


Figure-1: Workflow based approach for eliminating redundancy in virtual enterprising

Stage-2: Partitioning the global workflow into workflow modules: Based on the clearly identified functional blocks, the collaborating enterprises (or the dominating nucleus enterprise) may divide the global workflow into workflow modules. The collaborating enterprises will be given responsibility to realize (add details) one or more of the workflow modules; thus, collaborating enterprises get their own local workflows.

Stages 1 and 2 are based on a methodology proposed by Van der Aalst and Weske (2001).

Stage-3: Optimizing local workflow modules individually (locally): The collaborating enterprises work on the workflow modules that are allocated to them. Firstly, they add details to the workflow modules so as to reflect the business processes. Then, they optimize the workflow after finding and eliminating performance problems such as bottlenecks, redundancies, deadlocks, etc. though the enterprises are free to develop their own workflow modules as they wish, they can not change the already agreed interfaces between the modules.

Stage-4: Global optimization: The individual locally optimized workflow modules are joined together to form the collaborative workflow. Simulations are done on the collaborative workflow to see whether it satisfies the overall targets of the virtual enterprise. Simulations may reveal two types of performance problems: global and local.

- Global problems (such as overall delays, high product costs, etc.) affect the whole virtual enterprise; redesigning the initial global workflow with emphasis on redefining

the interfaces between the functional blocks, or re-dividing the global workflow into different set of functional blocks may help solve global problems. Local problems affect individual enterprises only.

- Local problems are solved by redesigning the local workflow modules.

4. USING PETRI NETS FOR ANALYZING COLLABORATIVE WORKFLOWS

This section only deals with the stage-4 "global Optimization" of the approach given in the previous section. Due to space limitation, stages 1-3 are not discussed any further. However, the methodology given in this section can be also applied sections 1-3.

This paper uses Petri nets for analyzing workflows. Petri net is a widely accepted discrete mathematic for modeling and simulation of discrete event-based systems. For more information on Petri nets, interested readers are referred to Peterson (1981), Cassandras and Lafortune (1999) or Dawis et al. (2001).

A Petri net model of collaborative workflow of a virtual enterprise is shown in Figure 2. The Petri net model consists of just 3 collaborators – a main assembler, a part supplier and a material supplier. In reality, a virtual enterprise may contain many layers of suppliers and distributors, and thus the Petri net model can be huge. Because of the huge size of the Petri net model, it is built module-by-module using the modular approach.

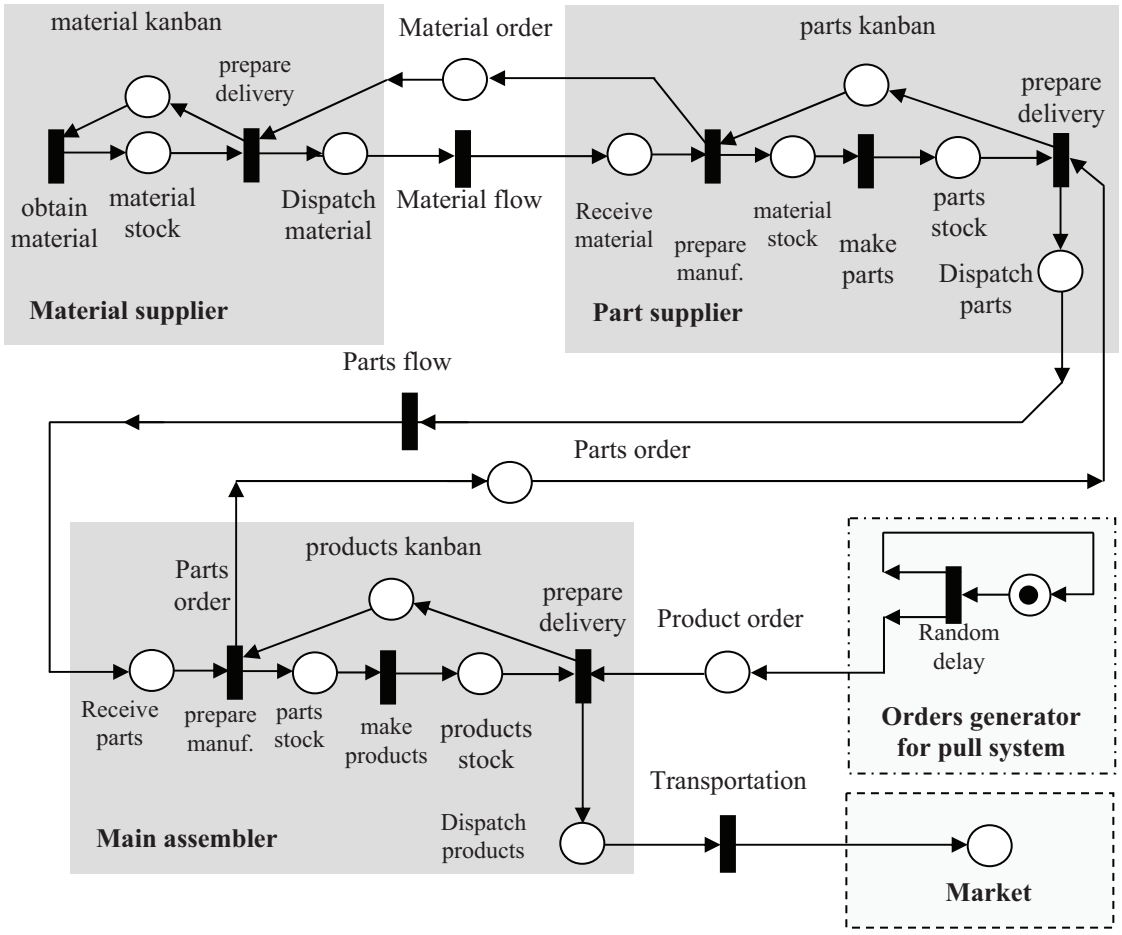


Figure-2: A simple Petri net model of collaborative workflow of a virtual enterprise consisting of a material supplier, a part supplier and a main assembler

The modular approach for Petri net model building consists mainly of modeling individual enterprises as modules, and then connecting the modules together through their input/output ports. The modular modeling approach is a three step process:

1. Modeling collaborating enterprises as event-graph modules with I/O ports
2. Reducing event-graph modules into minimal representations
3. Connecting minimal representations together to form the collaborative workflow

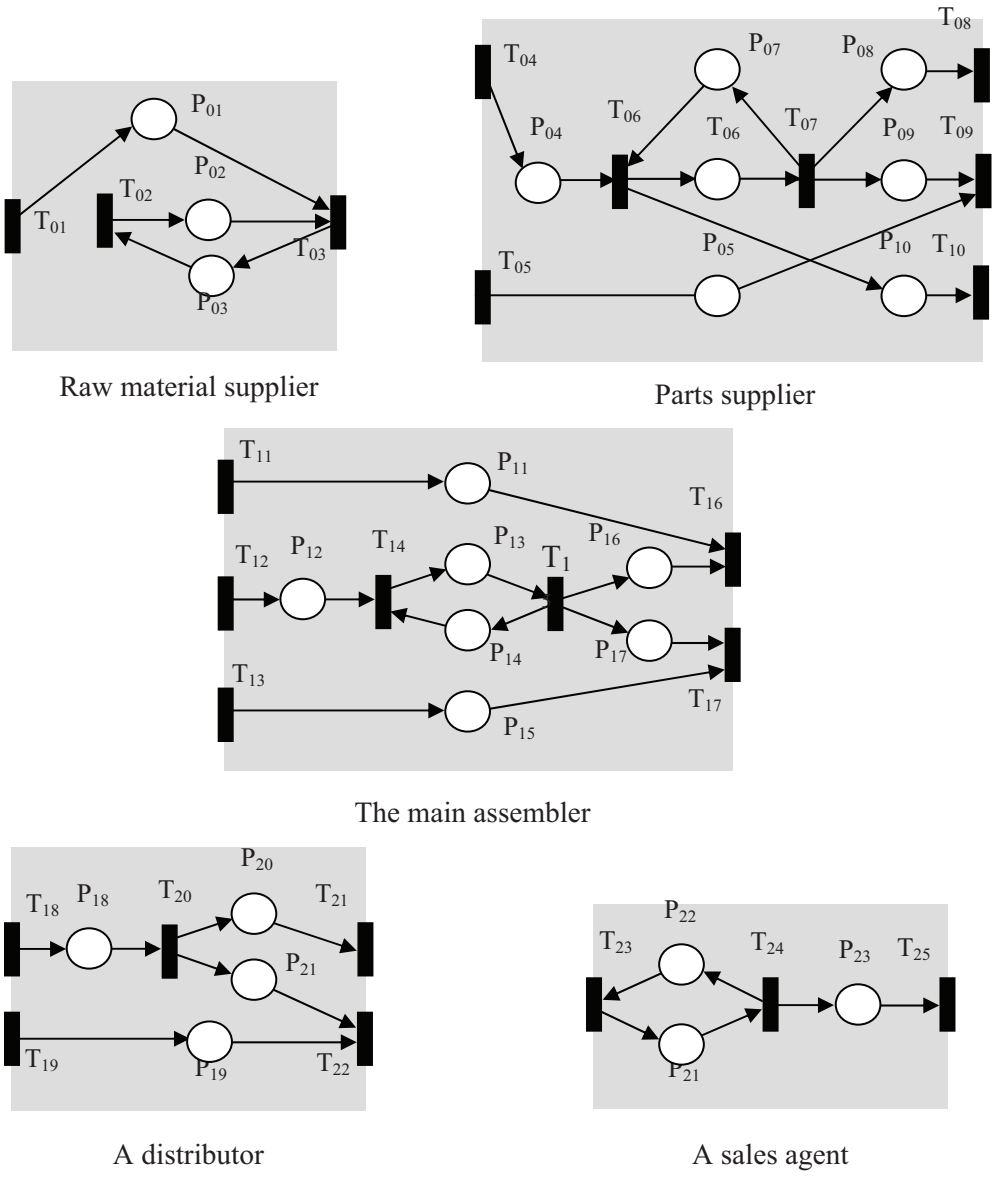
4.1 Step-1: Modeling Collaborating Enterprises as Event Graphs

In this first step, first of all, the collaborating enterprises of the virtual enterprise must be identified. Then, the collaborating enterprises must be modeled as event graph modules, as event graphs can be easily reduced into minimal size using existing theories; model reduction will be done in step-2. The event graph modules must also posses Input/Output ports (I/O ports); it is only through the I/O ports, the modules are going to be connected with the other modules in order to obtain the complete model.

Figure-3 shows modules of different types of collaborating enterprises in a virtual enterprise. These modules are *event graphs;* event graphs are Petri nets models in which all the places have exactly one input transition and one output transition. The description of places and transitions of the modules shown in Figure-3 is given in Table-1.

Table-1: Description of the modules for different kinds of enterprises

A raw material supplier			
T_{01}	Receive order from part supplier/assembler	P_{01}	Orders for material received.
T_{02}	Production of raw material.	P_{02}	Material ready for shipment.
T_{03}	Ship material to part manufacturer	P_{03}	Volume of material to produce.
A part supplier			
T_{04}	Material arrive (from mat. supplier)	P_{04}	Unloaded material in queue
T_{05}	Orders received from assembler	P_{05}	Received orders for parts
T_{06}	Production calculations	P_{06}	Ready for production of parts
T_{07}	Manufacture of parts	P_{07}	Monitor of quantity produced
T_{08}	Order raw materials	P_{08}	Monitor of materials used
T_{09}	Ship parts to main assembler	P_{09}	Parts ready for shipment
T_{10}	Send bid to main assembler	P_{10}	Bid for parts (to assembler)
Main assembler			
T_{11}	Bids for parts and raw materials	P_{11}	Received bids from suppliers
T_{12}	Parts and raw materials arrive	P_{12}	Unloaded parts in queue
T_{13}	Orders received	P_{13}	Ready for manufacture
T_{14}	Production calculations	P_{14}	Monitor of quantity produced
T_{15}	Manufacture of products	P_{15}	Received orders for products
T_{16}	Order parts and raw materials	P_{16}	Monitor of parts/materials used
T_{17}	Ship products to distributors	P_{17}	Products ready for shipment
A distributor			
T_{18}	Goods arrive from main assembler	P_{18}	Stock of goods
T_{19}	Receive orders for goods from sales agent	P_{19}	Received orders for goods
T_{20}	Supply and distribution calculation	P_{20}	Monitor of free capacity
T_{21}	Order goods from main assembler	P_{21}	Goods ready for shipment
T_{22}	Ship goods to sales agents		
A sales agent			
T_{23}	Goods arrive from distributor	P_{21}	Stock of goods
T_{24}	Sales	P_{22}	Monitor of free capacity
T_{25}	Order goods from distributor	P_{23}	Monitor of sales



Raw material supplier

Parts supplier

The main assembler

A distributor

A sales agent

Figure-3: Event graph modules of different types of collaborating enterprises

4.2 Step-2: Reducing Event Graph Modules

The second step is to reduce the size of the modules; Savi and Xie (1992) and Harhalakis et al (1991) show a reduction method that is suitable for reducing event graph modules surrounded by I/O ports (transitions). According to the reduction theorem, the minimal representation (reduced model) has the same set of input and output ports as the initial module, but has fewer internal places and do not has any internal transitions (Savi and Xie, 1992). Therefore, the removal of internal transitions and reduction in internal places greatly reduces the overall size of the complete model.

By reduction theorem, though simple event graph module called minimal representations replaces more complex modules of different kinds of enterprises, the liveness and boundedness properties of the original modules are preserved.

Figure-4 shows the minimal representations of the event graph modules that are shown in Figure-3.

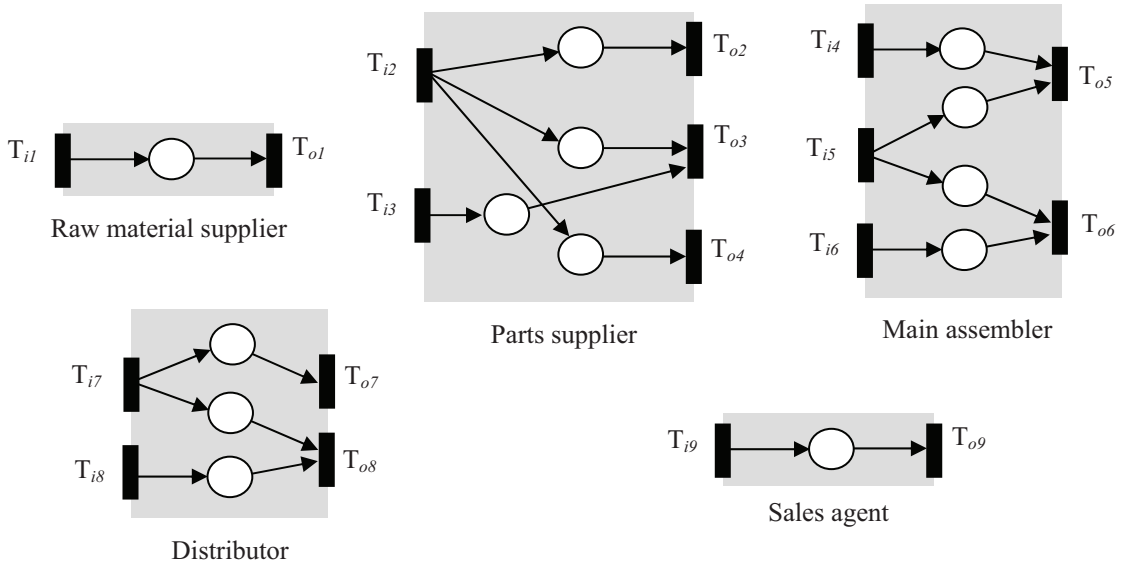


Figure-4: Minimal representations for different types of enterprises

4.3 Step-3: Connecting the Event Graph Modules Together

The final step is to connect the modules together to form a complete model of the virtual enterprise. The modules are connected through their I/O ports. Since the I/O ports are transitions, the connecting line should contain a place in between the modules.

5. A WORKING EXAMPLE

Figure-5 shows a collaborative workflow of a virtual enterprise. Since this example is given as a proof-of-concept, it is intentionally made simpler with just 12 collaborating enterprises. In figure-5, the event graph modules for the transporting agents are unique as these modules have one I/O port only as this port functions as both input and output port. Technically, this I/O port is a single transition. Also, the market is represented by an event graph module consisting of a single input port; there is no output port in this module, and hence it functions as 'sink' – consuming whatever passed to it.

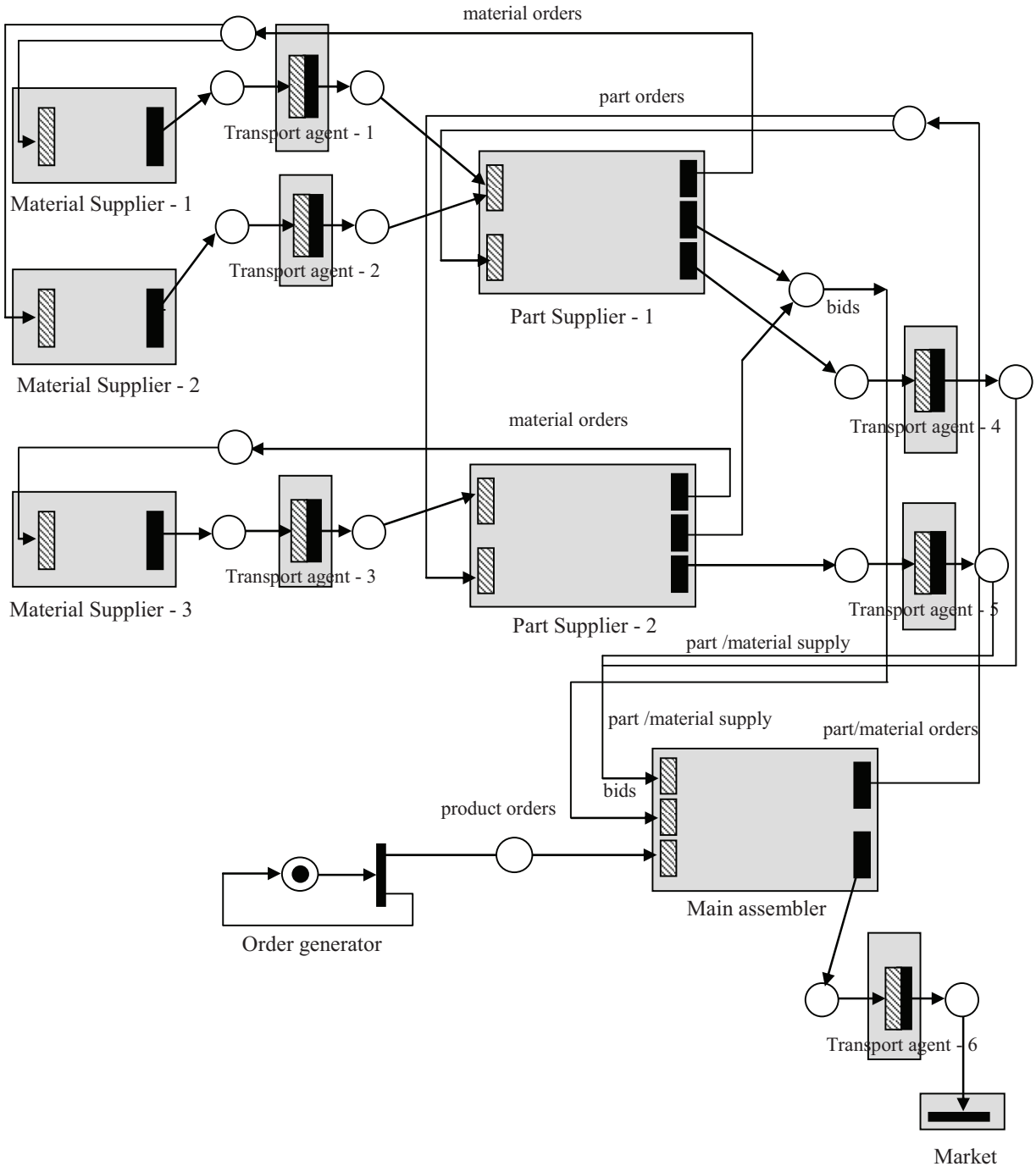


Figure-5: Model of a simple virtual enterprise obtained by connecting the modules for different types of collaborating enterprises

The tool general purpose Petri net simulator (GPenSIM, 2009) is used for simulation. GPenSIM uses colors to detect possible redundancy in the virtual enterprising. For more details on coloring (in Petri nets), interested readers are referred to GPenSIM user manual (GPenSIM, 2009).

5.1 Simulation Results

Simulation result is given below:

```
>> [simulation_results, colormap] = gpensim(workflow_demo, dynamic_info);
>> printsys(simulation_results, 'summary');

System: workflow-demo-sim-01
No. of modules = 14
** Modules **
Material-supplier-01
Material-supplier-02
Order-generator
Main-assembler
Transporter-01
Transporter-03
Material-supplier-03
Transporter-03
Part-supplier-01
Transporter-05
Transporter-04
Transporter-06
Part-supplier-02
Market

Total No. of places = 33
Total No. of transitions = 29


>> print_colormap(workflow_demo, colormap, 'duplicates')
** Duplicates: **
Transporter-01
Transporter-03

** Duplicates: **
Transporter-05
Transporter-04
```

Simulation results show that there could be two sets of redundant functions:

- Transporting agent 01, and Transporting agent 03 are perhaps transporting materials in the same region, thus can be combined. Similarly,
- Transporting agent 05, and Transporting agent 04 are perhaps transporting materials in the same region, thus can be combined.

6. CONCLUDING REMARKS

Different businesses from many different industries, have discovered a new way for them to succeed in the "global economy". It involves network collaboration on R&D, logistics, market projects, etc. As a result we can observe the virtual companies creation, and the transmission of businesses into peer networks that are supported by appropriate technology to give them the capabilities and competitive advantages of global enterprises.

Many companies join or create networks centred on market goals. They try to offer shorter lead time by creating sophisticated internet e-business architectures which directly link their

core businesses to their major customers and partners. But virtual companies have to sell and deliver collective offers to the market beyond what the individual companies could offer by themselves. So, they have to apply their strenghts, core activities and processes, and join them to strenghts and opportunities offered by other virtual company members. These virtual enterprises are undertaking significant collaborative product development work, using the large scale redundancy elimination process. The reason of this process is that a virtual enterprise network is a virtual team. It is made up of individuals from many different organisations with different processes, IT awareness, business cultures etc. The redundancy elimination seems to be the only way to the market success.

This paper shows a new approach for detection and elimination of redundancy in virtual enterprises. The approach uses workflows. The working example proves that the approach can be put to use by using a Petri net based modeling and analysis tool.

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QUALITY MANAGEMENT MODEL FOR BANKS – AN IPA & BSC INTEGRATED APPROACH

Dr. Ching-Wen Lin, National Ilan University, Taiwan,
cw.ilovetoto@gmail.com
Dr. Fu-Ju Yang, Chinese Culture University, Taiwan,
fuju@faculty.pccu.edu.tw
Kai-Lien Chen, National Taiwan Normal University,
kailien2001@yahoo.com.tw

ABSTRACT

The financial service industry is considered to contain high tech and high knowledge, and in addition to adhering to conventional wisdom of a conservative management approach, financial service providers should stay proactive and innovative in developing new services. Therefore, modern banks must focus on the construction of a comparative/measurement model, develop and manage internal intellectual capital, and commit to continuous improvement in management. This paper applies the methodology and structure of IPA and BSC to analyze quality gaps of all types of intellectual capital and determine tangible suggestions to lessen the quality gap under an integrated BSC structure. It is hoped that the research finding can serve as a reference to bank management in the pursuit of business excellence with the concept of TQM.

Keywords: financial institutions, e-finance, financial innovation, TQM, IPA

INTRODUCTION

1. Research background and motives

The financial services industry boasts high-tech and high-knowledge content. Shih (2008) suggested that the contribution of financial institution management is to be innovative with the collective knowledge and experience of all individuals through enhancement and integration, within the platforms constructed by financial institutions, which would improve the quality of services and operations on an overall level and satisfy the financial needs of customers. The continuous development of knowledge forms an important resource in the financial industry. By continuing to improve products, services, and developing networks, financial institutions are able to create greater business opportunities because they are able to reach more consumers and provide personalized services. Intangible intellectual capital, such as the development of talents and innovative products, has become a key focus for the financial industry of modern times. Therefore, it is critical to measure and assess intellectual

capital. For these organizations, intellectual capital is an important concept and knowledge is a precious resource. The creation of knowledge comes from a group of employees who have the capability and enthusiasm. They are able to convert the knowledge owned by organizations into intellectual capital with appropriate methods and effectively accumulate such intellectual capital within organizations. For managers, the utilization of intellectual capital is prerequisite to the creation of competitive advantages. Stewart (1997) pointed out that intellectual capital should be a value driver for an organization, as an important organizational economic resource, as well as a factor that boasts direct impacts on market competitiveness. With the potential developed in the knowledge economy, the competitiveness of companies improves along with the enhancement of intellectual capital. Therefore, many tools in knowledge management and innovation carry increasingly strategic implications for companies and have a heavier weight in target achievements.

Corporate managers realize that accounting information cannot fully disclose non-financial information so they gradually placed more emphasis on the measurement of non-financial performances. Some companies attempt to use certain strategic methods to manage intellectual capital. For example, Edvinsson and Malone (1997b) established an intellectual capital system for Skandia, a financial company, in order to effectively manage the company's intellectual capital. Over the course of 6 years, 75% of expenses were saved and the productivity increased 400%. According to Fruin (1997), Toshiba boosted its productivity by 20% with effective management of intellectual capital. Lynn (1998) also indicated that Dow Chemical saved US$40 million in patent expenses with the measurement and management of intellectual capital. These innovative approaches in industries sparked a wave of discussions in academics. Many studies confirm that intellectual capital is a value driver of companies. Intellectual capital is considered the most powerful tool, or asset, in the enhancement of corporate competitiveness (Edvinsson and Sullvan, 1996; Ittner and Larcker, 1998; Stewart, 1997; Ulrich, 1998; Johnson, 1999; Bontis, 2001; McElroy, 2002).

When the Financial Modernization Act (Gramm-Leach-Bliley Act or GLB Act) of 1999 was approved by Congress, financial institutions began a wave of mergers and acquisitions. The banking industry used M&A as a means to improving their operational soundness, reducing costs, and pursuing economies of scale and scope to boost their competitive advantage. The key to the success of mergers in the banking industry is the integration of cultural differences within the organizations (McCormick, William and Taylor (1995); Hayes (2001)). In the financial service industry, services and relationships are often regarded as innate characteristics that affect performance (Wang, 2002). Managers in the financial service industry satisfy the needs of customers by contributing their knowledge and experience to meet performance requirements. In contrast to other fields, the elements of intangible assets are more important. Tzeng's (2002) study in Taiwan showed that, as many as 94.74% of banks regard the management of intellectual capital as essential. Over 81.93% of banks think

it is necessary to design a measurement tool to assess the true value of banks, including the value of intellectual capital. The maintenance of customer relationship, the screening of employee quality, and the integration of system technologies are all the issues that need assessment in terms of intellectual capital. Therefore, banks should acknowledge and exercise their intellectual capital, in addition to the construction of a better measurement tool to assist management and development of intellectual capital within organizations.

Deming (1982) indicated that when consumers have more options, old and new banks would be faced with intensified competition. Banks, as part of the financial service industry, emphasize that they are customers oriented and focused on service quality and efficiency to win support and repeat businesses from customers. According to the concept of service quality gaps, by Parasuraman, Zeithaml, and Berry (1988), the implementation, inspection, and management of intellectual capital may experience a gap in quality management between customers and companies. This paper adopts the concept proposed by Wu An-Ni (2002a) that BSC (Balance Scorecards) can assist companies in understanding value creation drivers. This combined ideas by Probst, Raub, and Romhardt (2000), and used BSC as a tool to examine and manage intellectual capital of banks.

This paper first reviews literature to establish a measurement tool in intellectual capital for the reference of the banking industry. Then, it uses the structure of BSC to explore the gap in the operations of intellectual capital, perceptions of employees' performances, and the emphasis placed on customers in the banking industry. An analysis is performed on the variances in association with the conversion of perceived service quality into intellectual capital of banks. Finally, this paper refers to the above-mentioned gap and formulates a strategic map of intellectual capital for banks, via the BSC model. The purpose of this paper is to examine the gap between perceived quality between the front-desk employees and customers of banks, and identify the gap in operations of intellectual capital. It is hoped that these research findings can serve as a reference for the learning and growth of banks, and assist them in total quality management.

LITERATURE REVIEW

1. Intellectual Capital

Intellectual capital is a hot topic that all companies around the world have to take heed of in the 20th century. Stewart (1994) was the first to give a substantial definition of intellectual capital. Intellectual capital is defined as the aggregation of everybody's knowledge and competences that bring about competitive advantages and wealth creation. Edvinsson and Malone (1997a) suggested that any information that can be converted into something valuable is intellectual capital. They indicated that intellectual capital is the hidden link between market value and book value of companies. It may be goodwill or technical

capabilities. The core of intellectual capital is to allow companies to express their true value. Edvinsson and Malone (1997b) mentioned that the structure of intellectual capital is the combination of human capital and structural capital. Customer capital includes customer and knowledge capital.

Dzinkowski (2000) considered the total inventory of capital or knowledge equity owned by organizations as "intellectual capital". Therefore, intellectual capital is the intellectual properties or assets transferred by knowledge. It can also be the mechanism of knowledge transfer. Lev (2001) indicated that intellectual capital is a key driver for the growth of organizational value and the main component is the creation of future growth. McElory (2002) suggested that the past studies on intellectual capital failed to capture "social innovation capital" and emphasized that social innovation capital boosts enterprise value with mutual trust, mutual benefits, shared knowledge, and Internet norms. Bose (2004) reiterated that in the era of knowledge economy, only knowledge-based companies could be successful.

To sum up, Brooking (1996) prioritized the effective use of intellectual properties. Ulrich (1998) focused on the human elements. Michael and Martin (2003) pointed out the "corporate recipes". Stewart (1994), Johnson (1999), Dzinkowski (2000), and Hubert Saint-Onge (1996) suggested that intellectual capital covers people-oriented capital, structure capital based on technological-procedures, and customer capital focused on customers. Therefore, this paper divides intellectual capital into three dimensions, i.e. human capital, structure capital, and customer capital.

Generally, the core value of human capital is a set of skills which an employee acquires on the job, through training and experience, and which increase an organization's value in the future (Bontis et al. (1999); Edvinsson and Malone (1997); Grantham and Nichols (1997); Booth (1998); Brooking et al. (1998); Hubert (1999); Johnson (1999); Knight (1999); Dzinkowski (2000); Pulakos and Arad (2000); Carpenter (2003); Chen et al. (2004); Green, A. (2004) and; Powell (2004)). In addition, Meer-Kooistra and Zijlstra (2001) and Wang and Chang (2005) theoretically and empirically analyzed the relations among human capital and other elements of intellectual capitals. The human capital, which is composed of human knowledge and experience, is the ruling element and the foundation of other elements, and will indirectly affect business performance. Michael and Martin (2003) further divided organizational members into employees and management. They argued that different roles bring different values to companies and all members have to understand the roles they are playing to maximize the benefits of intellectual capital.

Structural capital aims to make it possible for employees to increase business performance based on their knowledge and competence. Dzinkowski (2000) divided structural capital into intellectual properties and infrastructure assets. Michael and Martin (2003) suggested that structural capital should cover internal structural capital, including intellectual properties and corporate operational flows. Chen, Zhu, and Xie (2004) indicated

that the contents of structural capital include corporate culture, organizational structure, organizational learning, operational flows, and information to assist in the efficient operations of companies and systems. Structural capital can be divided into process capital and innovation capital (Bontis et al. (1999); Bassi and Van Buren (1999); Johnson (1999); Knight (1999); Bontis (2002); Choo and Bontis (2002); and Wang and Chang (2005). Process capital represents the methods by which the company creates value, sample assets including management procedures and processes, administrative staff expertise and relationships with vendors. Luecke and Katz (2003) suggested that innovation capital from an organizational perspective is generally understood as the introduction of a new product or method.

Customer capital refers to the relationship between a company and its customers. Customer capital itself is a major mechanism that translates structural capital into value. Stewart (1997) indicated that the expansion of customer capital leads to relationship capital, and argued that the interaction between organizations and customers consists of depth (penetration), width (coverage) and stickiness (loyalty). Dzinkowski (2000) mentioned that customer (relationship) capital means customers, customer loyalty, distribution channels, and the recognition of corporate partners, good contracts, and license agreements. The most important of all, Stewart (1997) emphasized three key elements, which are human capital, structural capital, and customer capital. Any single one does not generate intellectual capital. Rather, companies have to own all three elements simultaneously and only with interactions between the three elements can competitive advantages be created.

2. Balanced Scorecard

In changing environments, where competition is fierce, financial information cannot fully represent the complete picture of the operating performances of companies. Financial statements do not convey information regarding corporate value. Kaplan and Norton (1990) studied 12 industries and published the concept of a balanced scorecard system (BSC). Scholey (2003) pointed out that balanced scorecard is the most influential strategic management tool of the past 75 years. Kaplan and Norton (1992) further defined balanced scorecard by combining the strategic targets and key performance indicators, as set forth by companies. It is a strategic management tool, which strikes a balance between long-term and short-term goals, financial and non-financial indicators, external and internal dimensions, lagging and leading indicators, and subjective and objective performance indicators. Niven (2002) emphasized that balance is the core concept of this system, especially the balance between financial and non-financial indicators, internal elements (corporate flows, learning, and growth), external elements (shareholders and customers), and lagging and leading indicators.

Knight (1999) used balanced scorecard to measure and discuss the management of intellectual capital with 4 dimensions, i.e. financial, customers, flows, learning, and growth.

Wu An-Ni (2002b) suggested that balanced scorecard is able to assist companies in understanding of the drivers of value creation, and value drivers are intellectual capital (Figure 1). In other words, it is argued that balanced scorecard can serve as a structure for the management tool of intellectual capital. However, Probst, Raub, and Romhardt (2000) suggested that balanced scorecards are lacking in indicators of the inventory of intellectual capital, and cannot serve as a measurement for knowledge management from the "knowledge" perspectives. To sum up past studies, there is correlation between the different items of intellectual capital. The establishment of balanced scorecard as a knowledge inventory system could be helpful. The management of intellectual capital and balanced store cards includes both strategies, as they both use indicators as the management tool. The management of intellectual capital focuses on both inventory and indicators of effectiveness. It also takes into account the scope of knowledge management. On the other hand, the management of balanced scorecard introduces the concept of strategic maps and differentiates performance driving factors and result indicators, and thus, indicator management can be more effective. This paper attempts to combine intellectual capital and balanced scorecard as two management tools for the examination of the implementation gap in the management of intellectual capital in the banking industry. Through the measurement of gaps in indicators, for all the dimensions of intellectual capital of the banking industry, its employees (internal parties) and customers (external parties), this paper establishes a management tool that integrates the concepts of intellectual capital and balanced scorecard. It is hoped that this tool can be applied in the financial service industry for total quality management to effectively manage service quality and enhance operational performances.

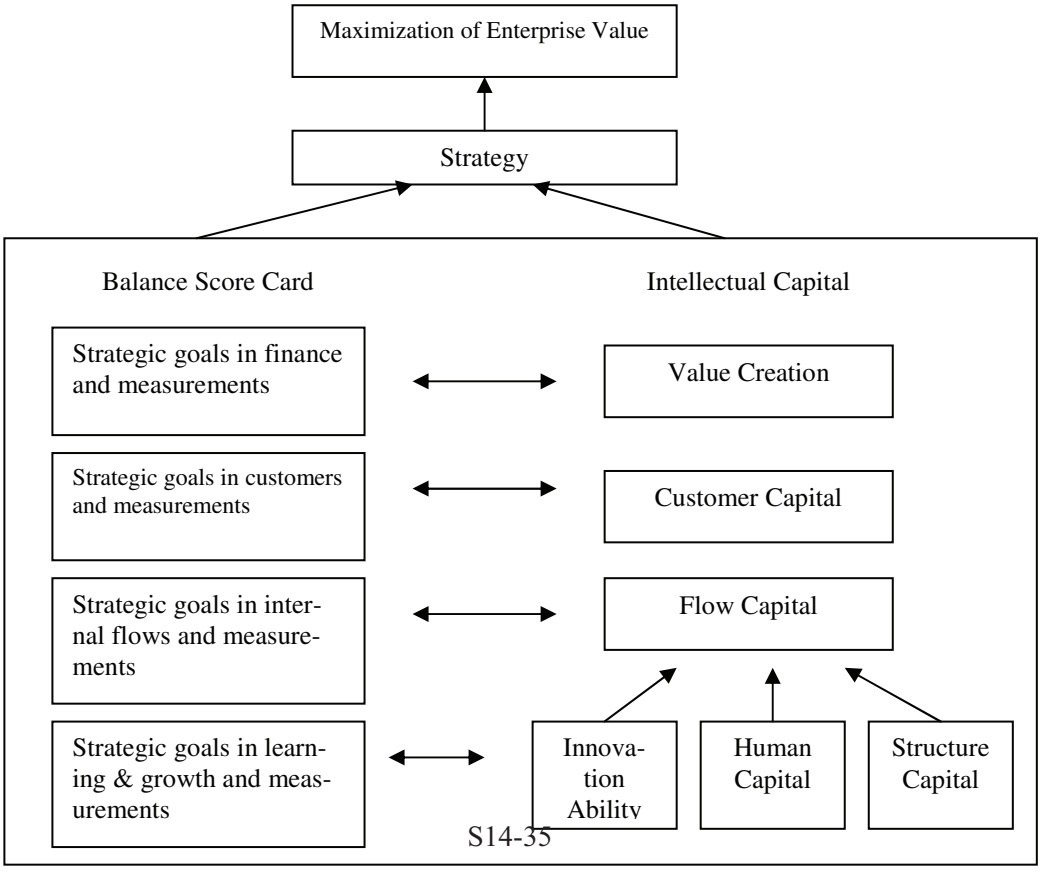

Figure 1 Combination of intellectual capital and Balanced Scorecard
Resource: Wu (2002b)

RESEARCH STRUCTURE AND DESIGN

1. Research structure

The purpose of this paper is to establish an understanding of the gap in perceived quality between employees (internal) and customers (external) of banks, and concerns all the indicators of the different dimensions of intellectual capital (i.e. human capital, structural capital, and customer capital), with the perspectives of balanced scorecard. In other words, the goal is to identify the gap in respective measured dimensions of intellectual capital in the eyes of employees (internal) and customers (external). This paper created its structure by modifying Importance performance analysis (IPA) (Figure 2), as proposed by Martilla and James (1997). It also adopts the viewpoints of Hollenhorst, Olson, and Fortney (1992) by dividing the research models with the average values of X-axis and Y-axis (Figure 3). This paper aims to identify the gap in intellectual capital that falls into Zones B and D (Figure 3), according to the self-assessment performances of employees and the levels of emphasis on customers, respectively. It is hoped that the research findings can lead to new methods of service quality improvements, to promote banks to learn and grow to enhance their intellectual capital and boost the real enterprise value.

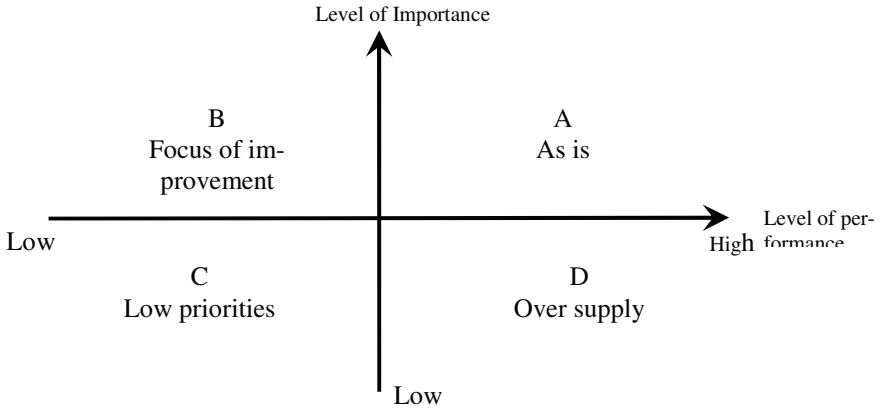

Figure 2 IPA Model
Source: Martilla and James (1997)

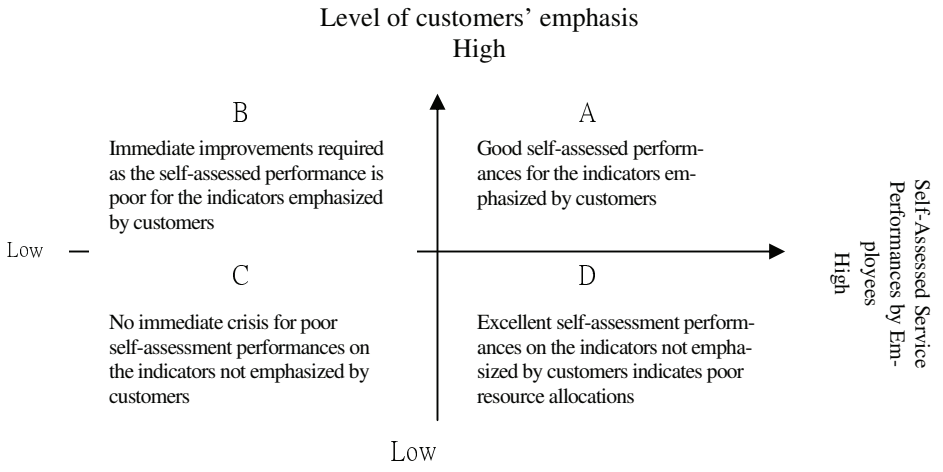

Figure 3. Model of this paper's - self-assessment service performances by employees and levels of emphasis placed on customers

2. Research design and methodology

Based on the above mentioned research purposes and structure, this paper proposes 3 research questions as follows:

(1)Are there any significant gaps between the self-assessed performance of human capital, by employees, and the levels of emphasis placed by customers on human capital of banks?

(2)Are there any significant gaps between the levels of focus, based on the employees' self-assessed performance of structural capital, and the levels of emphasis placed on customers by structural capital?

(3)Are there any significant gaps between the levels of employees' self-assessed performance of customer capital and the levels of emphasis placed by customers on customer?

The issue examined by this paper is intellectual capital from the perspective of balanced scorecards (customer dimension, internal flow dimension, learning, and growth dimensions). It includes human capital, structural capital, and customer capital. This paper refers to literature for the operational definitions and measurement variables of the individual dimension factors and to establish the foundation of the survey questionnaire. According to the definition detailed in Article 20 of the Banking Act, banks in the R.O.C. can be divided into three major categories: commercial banks, professional banks, and investment trusts. This paper samples the employees and customers of commercial banks in the Greater Taipei

Area as the population. A survey by the Bureau of Financial Affairs, Ministry of Finance shows that there were 40 commercial banks, as of November 2006, in Taiwan. In order to gain an understanding of the perceived gap between employees and customers in intellectual capital, based on balanced scorecards, this paper samples the employees of the top three commercial banks, with the highest market shares (with a combined market shares of approximately 20%), in the commercial banking market of Taiwan. The sample of customers is generated by selecting from the customers of the banks where these employees work. A total of 300 questionnaires were released to the customers of the banks where the employees work. After the elimination of ineffective questionnaires, there were 248 effective questionnaires answered by the employees, and 292 questionnaires answered by the customers, with recovery rates of effective questionnaires of 82.67% and 97.33%, respectively. The questionnaires were released from January 3, 2007 through February 14, 2007. This paper utilizes SPSS (a statistical program) and IPA as the analytical tools to perform descriptive statistical analysis, reliability analysis, t-test of independent samples, and Importance-performance Analysis (IPA).

EMPIRICAL RESULTS AND ANALYSIS

1. Validation of gaps in intellectual capital of banks

The Validation of the First Gap in Intellectual Capital: There is a significant difference between the levels of performance in human capital, as self-assessed by employees, and the levels of emphasis placed by customers on human capital of banks. Table 1 shows the test results, and whether there is a gap. There are significant variances in all 11-measurement variables of human capital ($P<0.05$), indicating significance differences between the levels of performances in human capital, as self-assessed by employees, and the levels of emphasis placed by customers on human capital of banks.

Table 1 Validation of gap in human capital of banks

	Questions	T value	P value
1	The staff turnover is low in general.	-4.829	0.000**
2	The average education levels of the employees at our bank are above the industry average.	-2.131	0.034*
3	If any employees leave, it will cause great disruptions in operations at our bank.	2.955	0.003**
4	The employees of our bank can all work to their strengths.	-7.648	0.000**
5	The employees of our bank often share experience and learn from others.	-4.949	0.000**

6	The employees of our bank often keep themselves up to date for professional skills.	-7.257	0.000**
7	The relationships across functions at our bank are good.	-6.369	0.000**
8	The team work at our banks is good.	-8.214	0.000**
9	The employees at our bank are satisfied with their work.	-7.052	0.000**
10	The knowledge and skills of the employees at our bank are sufficient to solve problems at work.	-6.558	0.000**
11	The employees at our bank can identify with the organizational philosophy of your company.	-5.697	0.000**

Source: This study

Validation of the second gap in intellectual capital:

There is a significant difference between the levels of performances in structural capital self-assessed by employees and the levels of emphasis placed by customers on structural capital of banks. Table 2 shows the test results, and whether there is a gap. There are significant variances in all 11 measurement variables of structural capital ($P<0.05$), indicating significance differences between the levels of performances in structural capital self-assessed by employees and the levels of emphasis placed by customers on structural capital of banks.

Table 2 Validation of gap in structure capital of banks

	Question	T value	P value
1	The overall operational flows of our bank are smooth.	-9.122	0.000**
2	Our bank has comprehensive databases for inquiries.	-9.075	0.000**
3	Our bank tightly integrates the internal workflows with technologies.	-6.359	0.000**
4	Our bank is effective in operations and management.	-10.092	0.000**
5	In our bank, departments and employees can quickly support each other.	-8.414	0.000**
6	Our bank emphasizes the development of new technologies and the introduction of new techniques in product development.	-8.038	0.000**
7	Our bank is able to quickly develop new products to meet market demands.	-5.977	0.000**
8	The number of the completed new projects by our bank each year is above industry averages.	-6.082	0.000**

9	The R&D resources allocated by our bank each year are above industry averages.	-5.985	0.000**
10	Our bank is able to provide an environment where employees can share skills and knowledge.	-8.241	0.000**
11	Our bank encourages employees to innovate and tolerates adventures, mistakes, and failures.	-10.064	0.000**

Source: This study

Validation of the third gap in intellectual capital:

There is a significant difference between the levels of performances in customer capital self-assessed by employees and the levels of emphasis placed by customers on customer capital of banks. Table 3 shows the test results, and whether there is a gap. There are significant variances in 18 measurement variables of structural capital ($P<0.05$), with the exception the question "There are regular transactions and activities between employees and customers" ($p=0.117$). This indicates significance differences between the levels of performances in structural capital self-assessed by employees and the levels of emphasis placed by customers on structural capital of banks.

Table 3 Validation of gap in customer capital of banks

	Question	T value	P value
1	Our bank actively develops new customers via media and campaigns.	-4.637	0.000**
2	Our bank places great focus on the responses and feedback of customers.	-4.130	0.000**
3	Our bank has special projects to serve customers so it is more competitive than its peers.	-6.923	0.000**
4	Our bank can satisfy the needs of customers.	-7.087	0.000**
5	Our bank is customer oriented.	-5.792	0.000**
6	Our bank provides value added services to customers.	-5.676	0.000**
7	The image and branding of our bank is better than industry averages.	-4.648	0.000**
8	Our bank has a good market image and reputation.	-5.505	0.000**
9	The quality of the products or services offered by our bank is high.	-6.522	0.000**
10	The customers of our bank are highly loyal.	-6.609	0.000**
11	The rate of complaints from customers is low at our bank.	-8.570	0.000**

12	The customers of our bank are highly satisfied with services.	-7.817	0.000**
13	The customers of our bank are highly satisfied with our products.	-10.256	0.000**
14	The probability for customers of our banks to repeatedly purchase our products is high.	-4.896	0.000**
15	The interactions between the employees of our banks and our customers are frequent.	-1.572	0.117
16	Our bank places more emphasis on customers needs than on company profits.	-6.426	0.000**
17	The employees of our bank have good interactions with customers.	-3.849	0.000**
18	The employees of our bank provide transactional services with great accuracy and efficiency.	-4.748	0.000**

Source: This study

2. IPA

Among the 11 measurement variables of human capital that report significant statistical results, the two options “Employees are satisfied with work performances” and “The average educational level of employees is above industry average” falls in Zone B and Zone D, respectively. This shows that resources for these two items are not properly allocated by banks (Figure 4). Among the 11 measurement variables of structural capital that report significant statistical results, the two options “Our bank tightly integrates the internal workflows with technologies” and “Our bank is able to quickly develop new products to meet market demands” fall in Zone D. This indicates that banks allocate too many resources in the item of structural capital not emphasized by customers (Figure 5). Among the 18 measurement variables of structural capital that report significant statistical results, the options “Our bank has a good market image and reputation”, “The rate of complaints from customers is low at our bank”, and “The customers of our bank are highly satisfied with our services” fall in Zone B. Meanwhile, the option “The probability for customers of our banks to repeatedly purchase our products is high” falls in Zone D. The results show that banks misallocate resources in these items (Figure 6).

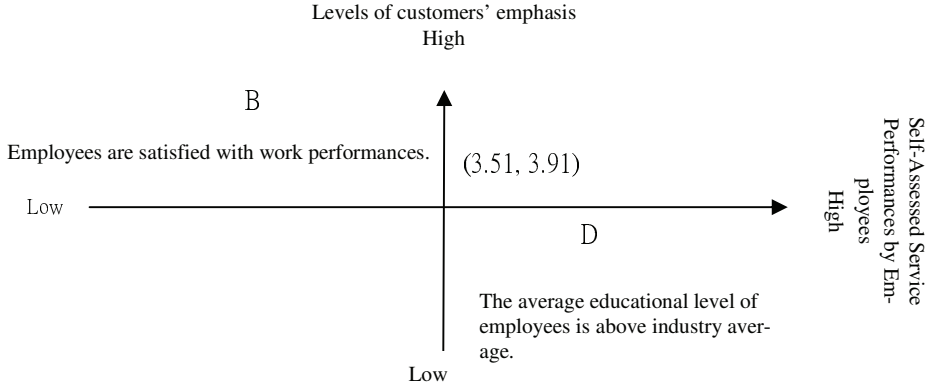

Figure 4 IPA Quadrants of Human Capital of Taiwanese Banks

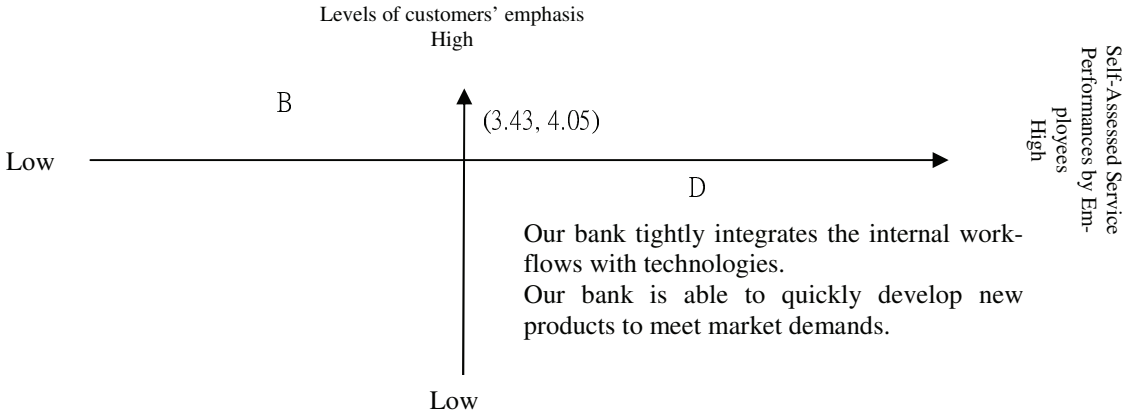

Figure 5 Quadrants of Structure Capital of Taiwanese Banks

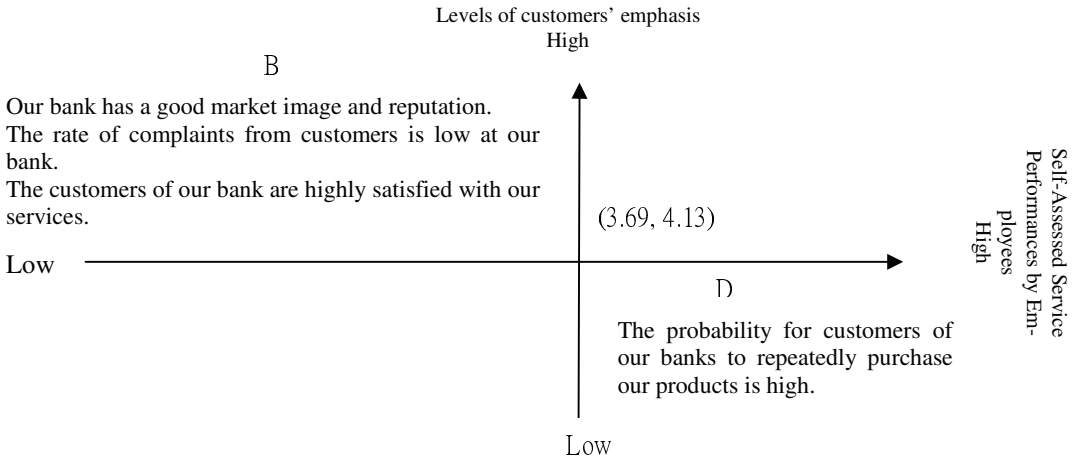

Figure 6 Banks Misallocate Resources Items

CONCLUSIONS AND SUGGESTIONS

1. Gap in intellectual capital

The empirical analysis shows that there are perceived gaps in human capital of banks. The option "Employees are satisfied with work performances" is considered to be important by customers, but not by bank personnel. On the other hand, banking personnel believes that their education level is important, but it is not emphasized by customers. This may be because that the banking industry in Taiwan is conservative, and they select personnel based

on academic background and written resumes; however, this approach does not seem to meet with the expectations of customers. An issue worth noting is, whether the screening of employees should be based only on examination results and academic achievements. Meanwhile, the indicator that customers emphasize the most is "The knowledge and skills of the employees at our bank are sufficient to solve problems at work". Therefore, in addition to adhering to the conventional wisdom of conservatism, banks should consider whether they should add innovative services, and more sophisticated service contents, in the work attitudes of employees and in operational management. Banks should place focus on the management of service quality by providing comprehensive internal training to enhance their professional competences. Traditionally, the studies on human resource management all agree that employees' high satisfaction with work naturally boosts productivity. Unsatisfied employees are low in morale; as a result, performances may deteriorate and organizations will suffer greatly (Fitzgerald(1996); Buchbinder (1998)). Meanwhile, Cheung and Scherling (1999) suggested that the redesign of work procedures and job characteristics, the improvement of team dynamics, raise of salaries and promotions all help to boost job satisfaction of employees. In other words, modern banks should endeavor to ensure job satisfaction of employees to improve their service quality and performances across-the-board. It is not advisable to manage human resources in the way manufacturing industries do, by emphasizing efficiency and productive value. Chen, Zhu, and Xie (2004) also indicated that human capital is the foundation of intellectual capital. High satisfaction with work helps to boost morale and improve work attitudes of employees. Banks are advised to engage in TQM by following the above suggestions.

This paper finds that there are significant variances between the levels of performances in structural capital, as self-assessed by employees, and the levels of emphasis placed by customers on structural capital of banks. The options "Our bank tightly integrates the internal workflows with technologies" and "Our bank is able to quickly develop new products to meet market demands" fall in Zone D. Although banks believe that they have done a great job in the development of IT techniques and innovative products over recent years, customers do not value this as highly. This is in line with the finding of Shih (2008). Despite a focus on innovation, the financial service industry, in essence, is a traditional service industry that is relationship-oriented. Customer satisfaction is hinged on sufficient internal training and intensity of R&D efforts, rather than advanced digital systems in operations and support. Therefore, banks should refer to the finding of this paper in the development of internal flow capital and quality management, in particular, avoiding over-investments in the IT interface that customers use because it increases operational costs for no benefits. Meanwhile, customers place a heavy emphasis on "The customers of our bank are highly satisfied with our services", but banks do not really care "whether products can meet the needs of customers". Michael and Martin (2003) suggested that structural capital covers dimensions in

marketing and management. The allocations of flow capital are the leading indicators of performances, highly relevant to the future growth of companies. Therefore, banks should review whether the products they provide are what customers need to improve the quality of their structural capital.

This paper finds that, for the intellectual capital of the banking industry in Taiwan, the three options "Our bank has a good market image and reputation", "The rate of complaints from customers is low at our bank", and "The customers of our bank are highly satisfied with our services" fall in Zone B. This indicates that the banks do not believe they have performed well in the indicators emphasized by customers. In fact, the market structure in the banking industry is highly competitive. As soon as the reputation, complaint rate of customers, and satisfaction with products fall below customers' expectations, banks are likely to lose clients very quickly. Chen, Zhu, and Xie (2004) suggested that the loss of customers would quickly deteriorate the market value and future performances of companies. In addition, customer capital is a key determinant for other intellectual capital to convert into market value and corporate performance (Chen, Zhu, and Xie, 2004; Shih, 2008). The finding shows the importance of customer capital to banks.

The option "The probability for customers of our banks to repeatedly purchase our products is high" falls in Zone D. Banks seem concerned about whether customers repeatedly select the products (services) they provide. On the contrary, customers are not greatly concerned about this indicator. This may be due to the switching costs, or a relationship inertia, that keeps customers with banks. When the dissatisfaction is accumulated to a critical point, or other banks offer better incentives, customers would immediately walk away. If the option "The probability for customers of our banks to repeatedly purchase our products is high" is used as an additional indicator to the performance of employees, employees would work harder for repeated purchases. However, it may only push employees to use their techniques on customers. Banks do not pay as much as to "response and feedback of customers" and the actual "levels of satisfaction". Customers place more emphasis on these two items and banks should improve them.

2. Strategic map of intellectual capital of banking industry in the Balanced Scorecard Model

The management of intellectual capital at companies with the balanced scorecard system not only links the intellectual capital with financial performances, but also assists the banking industry to control the interactivity of different types of intellectual capital. The close integration of balanced scorecard and intellectual capital initiates improvements across-the-board of operating performances and quality. This paper links the quality gap of the three types of intellectual capital of the banking industry with the relevant balanced scorecards. It also combines measurement indicators and provides its finding as a hands-on reference for management of banks. According to the empirical results, the questions

"Employees are rather satisfied with work" and "The average education level of employees is above industry average" are the core measurement of employees for learning and growth, as a dimension of human capital in balanced scorecard. The questions "Our bank tightly integrates the internal workflows with technologies" and "Our bank is able to quickly develop new products to meet market demands" are the core measurement of operational flows, as a dimension of internal flows in balanced scorecards, regarding structural capital. The questions "Our bank has a good market image and reputation", "The rate of complaints from customers is low at our bank", "The customers of our bank are highly satisfied with our services" and "The probability for customers of our banks to repeatedly purchase our products is high" are the core measurement of customer value statements and customer core measurement, as a dimension of customers regarding innovative flows. This paper highlights the potential gap in the TQM program of the banking industry for intellectual capital, and structures a balanced scorecard system (Figure 7). Managers in the banking industry may use balanced scorecards as an effective measurement tool, and apply balanced scorecards to make gradual improvements in the dimensions of learning and growth. This will narrow the gap in implementations for intellectual capital, boost financial performances, and thus, increase the enterprise value of banks.

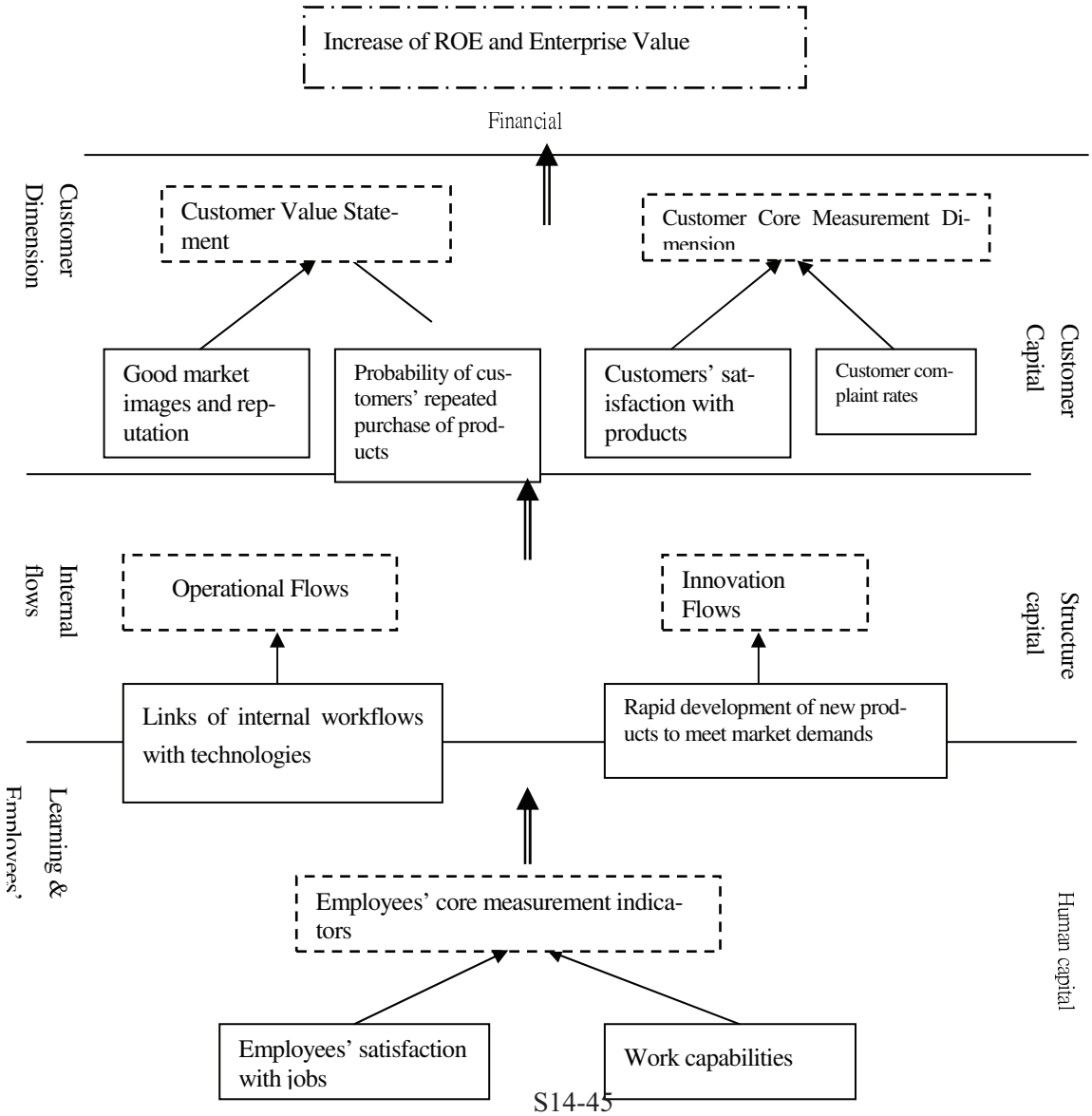

Figure 7 TQM strategic map of intellectual capital of banks in Taiwan

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EFFECTIVE ASSET MANAGEMENT TO IMPROVE THE SATISFACTION OF MOBILE TELEPHONE CUSTOMERS

Sanjay Ramsingh, Technical Field Engineer, Digicel, Trinidad and Tobago
Sanjay.Ramsingh@digicelgroup.com
M.K.S. Sastry, University of West Indies, Trinidad and Tobago
mks_sastry@ieee.org

ABSTRACT

Improving customer satisfaction and loyalty is increasingly becoming a great challenge globally. Regulated markets, competition from other service providers, customer habits of having more than one cell phone, complex standards and benchmarks are some of the major reasons for the mobile service companies to adopt new strategies to retain their customer base. Most service providers continue to use smart marketing strategies combined with attractive tariff schemes to capture the market. However, mobile telephone customer satisfaction and loyalty depend on several elements such as network coverage, availability/ usability of new handsets, call center quality, and online support. In this paper, an effective asset management strategy to improve the satisfaction of mobile telephone customers is presented. A state-of-art web-enabled management information system is designed and developed for the overall management of the technical and non-technical operations of a typical mobile company.

Keywords: Customer Relationship Management, Information Management System, Customer Satisfaction, Asset Management, Cellular Network Management, Work Management System

INTRODUCTION

Any typical mobile service company will have different departments such as Cell Site Maintenance Department, Facilities Department, Contracts Department, Transmission Department etc. Normally, all the departments will be monitored jointly by technical and corporate offices. The technical departments are responsible for providing high quality of network coverage without any interruption. Corporate offices deal with financial matters, business and customer related issues. Mobile companies use different strategies to manage the data and information within their departments. Corporate offices manage the customer database and do not provide access to other departments for various reasons. Similarly, technical information is not provided to corporate departments. This is mostly due to relevance of the information, professional background and routine responsibilities of the employees and to avoid unnecessary exposure. All these departments would have their information stored locally which makes it inaccessible to other departments although the information would be useful in getting day to day jobs done more efficiently. High network coverage and availability has been major factor for the customers to stick to a particular service provider than any other reason. Unlike other service sectors, the business of mobile telephony has two faces – Business to Customer and Business to Business. Network switching between different companies, different charges, penalties, guaranteed network availability and the range of services are the major factors governing the dimension of Business-to-Business dimension. The Business-to-Customer

dimension is governed by the factors like High quality network coverage and availability; Customer satisfaction, attractive tariff structures. In both cases, network coverage and high availability is the obvious common element and naturally will influence overall business model. Both business models expect the 24x7 uninterrupted services. In other words, companies with high quality network coverage without interruptions will certainly win a strong customer base.

TROUBLE CALL PROCESS

Whenever customers find any technical problems, naturally they contact the customer service department of the company using a toll free number. The customer service representative routinely checks with the caller if the problem is connected with the specific handset. If the problem is not connected to the handset, then a trouble ticket is assigned to that specific trouble call. Trouble ticket is a unique number for every network problem however small it is. The information of the problem along with the trouble ticket is forwarded to a customer care technician (CCT). Customer side faults are generally classified (or described) as Network Busy, No Coverage, Drop Calls, Unable to setup a call, Poor call quality. There symptoms are very broad and there could be several reasons and faults on the network side. The CCT will use the existing information and previous experiences to determine the average or most probable fault clearing time and inform the customer representative, who further relays the information to the customers in that area to avoid too many incoming trouble calls. Then the CCT will forward the information to Network Operations Centre (NOC) for further investigations.

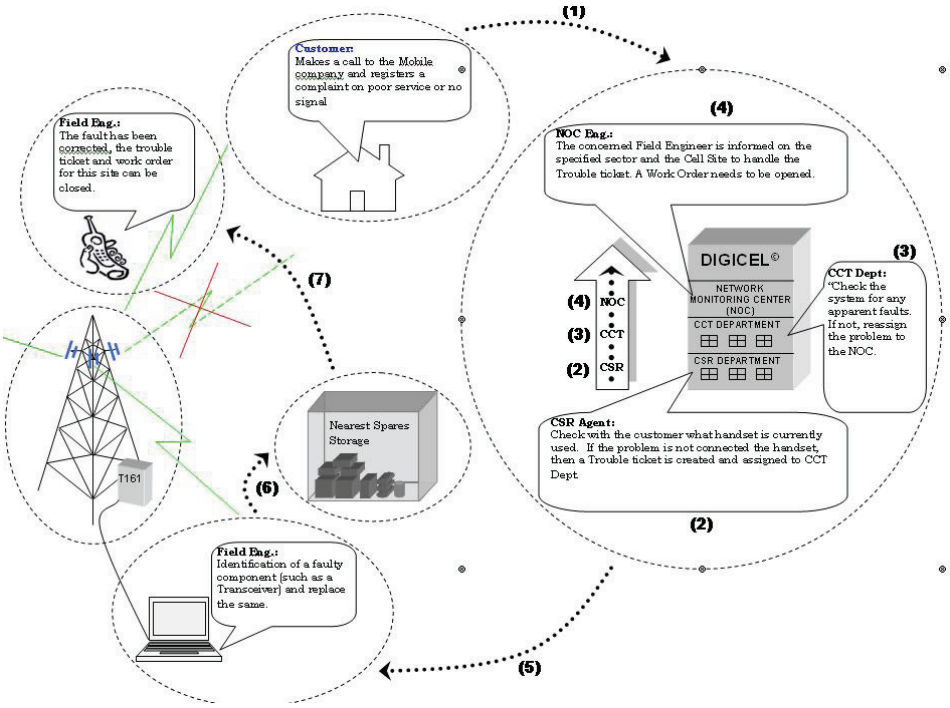

Figure 1: Work flow on a customer trouble call

The technicians of NOC monitor continuously the entire network for any problems. Most problems can be detected automatically by Netcool software (Netcool, 2008). The main objective of using Netcool is to process the fault signals from various devices in real-time. It

will display the fault type, location and the corresponding device so that technicians can take necessary remedial steps. In most cases, Netcool identifies only the network layer, but cannot pin-point the exact faulty component. Nevertheless, NOC sends a site engineer to the faulty zone to carryout necessary inspection, troubleshooting, fault identification, and problem correction. In many cases, site engineers need to request replacement of components from the most nearest stores or from the central stores. The question is who can help finding the availability of that specific component and location of the nearest store. In some case, the faults may be related to power generators or air-conditioners. In such circumstances NOC will notify the third party, independent contractors with whom usually the mobile companies will have prior agreements for undertaking maintenance on emergency basis. Once the faulty component is replaced, the network will be back to normal operation and then the loop of customer grievance will be closed. The overall working process of a typical network related fault is shown in Figure 1.

COMPLEX TECHNOLOGICAL ENVIRONMENT OF MOBILE NETWORKS

It can be seen from the above, the fault rectification process involves several issues involving human decisions, logistics and technical expertise of individuals, availability of spare components etc. To understand the complexity of the overall process, hardware backbone, proprietary troubleshooting software, real-time monitoring with Netcool and the interconnections are shown in Figure 2.

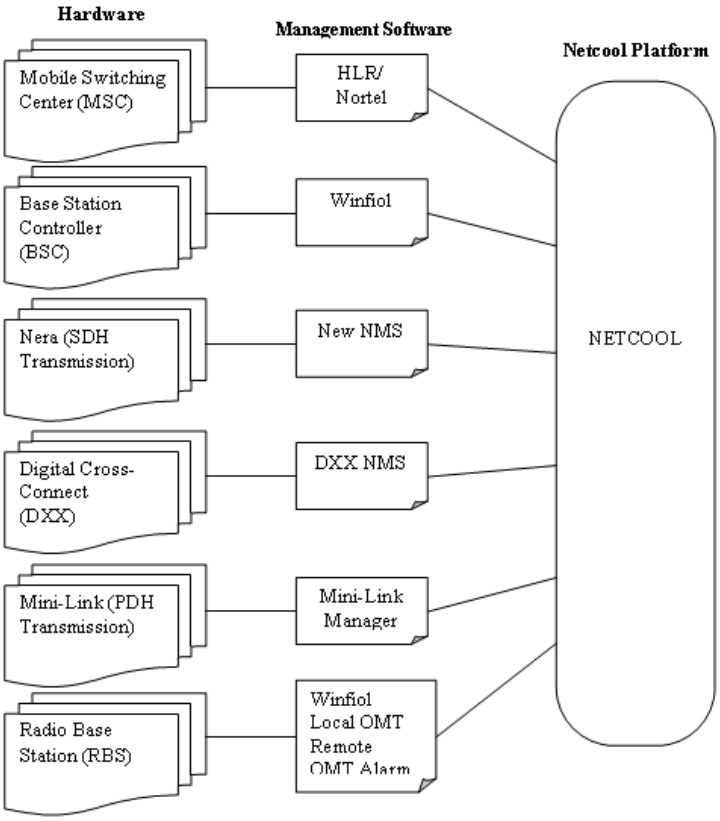

Figure 2. Schematic arrangement of Hardware and Software Monitoring with NetCool

NETWORK FAULT CLASSIFICATION

Though customer describes what is experienced in simple terms as 'no signal' or 'call droping', it is the responsibility of the NOC to pin-point the exact technical reason very quickly. Based on our experience, all possible network related faults are classified into categories with proper reasons and explanations. From the figure 2, it can be understood that hardware at each site can be specific and different from another site. Troubleshooting software is specific to the equipment and should be properly integrated into the components. Some of the components can be replaced by components manufactured by a different company, as long as the compatibilities are ensured. When the site engineer reaches the fault zone and identifies the nature of fault, then the faulty device/ component can be identified. For this, engineers should be trained on different components, their expected responses and the various faults with possible reasons. The detailed treatment of this fault classification is out of scope of this paper; however the summary is outlined in Table 2 with each network layer having different possible faults. The total possible faults in each category are also provided.

Table 1. Some of the Faults in different network layers

Network Component/ Layer	Types of faults (Not exhaustive)
Radio Base Station (Total 26 different possible faults)	Loop Test Fault/ Power Limits Exceeded Flash Corrupted/ SW Fault
Transmission Synchronous Digital Hierarchy (SDH) (Total 34 different possible faults)	Loss of Signal/ Loss of Frame / Software Fault/ Invalid Frequency on Transceiver
Transmission Plesiochronous Digital Hierarchy (PDH) (Total 24 different possible faults)	Radio Frame Fault/ Clock Loss Of Reference/ Transmitter OFF/ Software Fault Loss of Communication
Digital Cross Connector (Total 26 different possible faults)	Group Failed/ Missing Unit/Loss of Power Hardware Inconsistency
General Faults (Total 6 different possible faults)	Mains Failure/ Generator Fault/Low Fuel on Generator/ Vandalism (Cut Transmission Cable etc)

CHALLENGES WITH THE GEOGRAPHY

Caribbean Region with its vast mountain terrain and oceans poses challenging conditions for establishing mobile communication infrastructure and also general maintenance operations. The island nation Trinidad and Tobago (specifically the sister island Tobago) has irregular mountain terrains. The equipment is different from place to place. For example, four types of towers – a) Triangular type b) Monopole type c) Circular type d) Cell on Wheels (COW) are in use by the existing mobile companies. Low lands require taller towers than plain lands. High lands can use any of the towers. Plain lands use specific towers deepening on the application; COW or monopole is used for capacity; circular tower is used for distance coverage. However regulatory authorities restrict the height of the cell towers due to low flying air traffic. The backbone sites like SDH Synchronous Digital Hierarchy will not use COW or monopole because of the weight of the equipment. Trinidad has many off-shore oil and gas exploration platforms and facilities.

Usually cell towers are erected in costal areas close to the sea and direct the signal towards the sea for maximum signal availability. Some cases, the range is extended by combining transceivers, a special proprietary technique. Island to island network switching is carried out through existing fiber infrastructure belonging to another communication company or satellite link operated by international operators. Hence, it is implied that inter-island or international communications require network switching or transfer and there is a standard tariff attached to that.

Natural disasters like hurricanes, heavy rains, flash floods and lightening. In particular, lightening strokes have serious effect on the cell towers, despite the fact that all cell towers are protected by a lightening arrestor. Normally transmission equipment is burnt out, thus requiring complete replacement of the damaged units. It may be noted that Caribbean region has a high volume of hurricanes and lightening stroke every year. Combination of fiber optic and wireless backbone technologies are more applicable for Caribbean and are presently in use, due to the typical geographical conditions.

WEB ENABLED ASSET MANAGEMENT APPLICATION

From the above discussions, it is clear that network fault management is really the challenging task and requires coordination of several activities and resources. Free flow information is also vital for the maintenance activities. There are no existing software packages that are specifically suited for mobile communication companies to integrate all the maintenance activities. This paper provides the details of development of a web enabled software to integrate different departments, company assets and components and the customer. All the key facilities such as department, devices, components, technicians are modeled using relational database MySql. This application is developed using the open source technologies PHP MySql and HTML/ Java Scripting on MS Windows XP operating system. Java Script is used to client side scripting provide security, validation and also to reduce burden on server side. A typical relational model of different activities of typical a trouble call is shown in Figure 3.

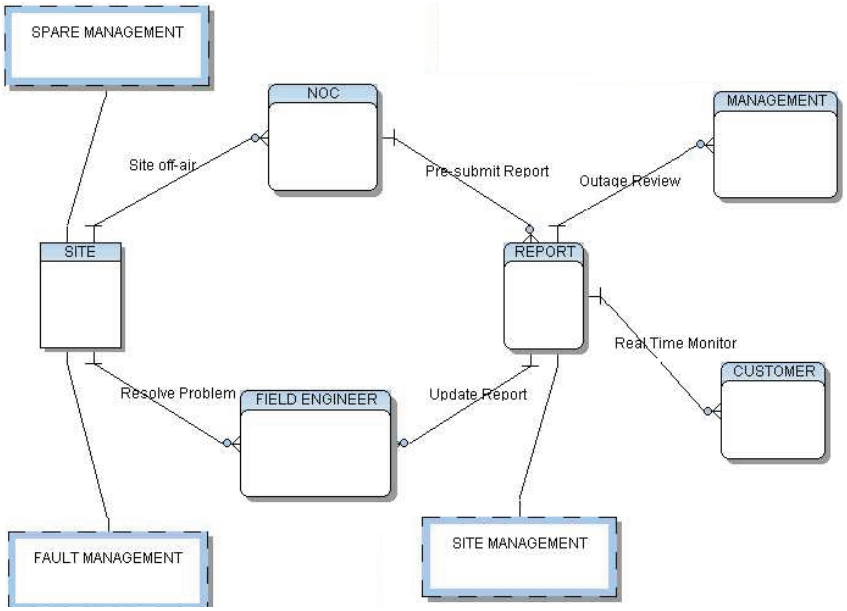

Figure 3. Section of Relational Data Model of different activities of typical a trouble call

The exhaustive treatment of database design is out of scope of this discussion. The complete database caters to several aspects of the mobile company activities including asset management, work management, inventory management, report generation and information management (specific information flow to customer and total information to the company), maintenance (including preventive, breakdown and emergency etc). The Overall Information Structure for Asset Management is presented in Figure 4. This application is used by different departments NOC, RF (Radio Frequency), Transmission, Maintenance, new installation, upgrades etc, all sharing the same information.

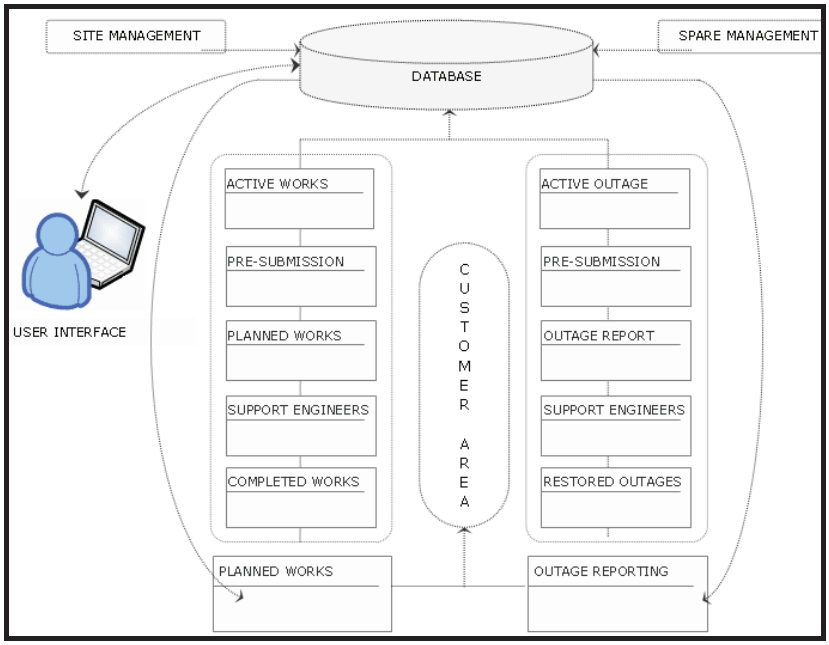

Figure 4: Overall Information Structure for Asset Management

Also not much emphasis was placed on backup power (generators), mobile companies have of late started seeing the large impact that standby power units have on overall network availability. From observations a lot of downtime is experienced as a result of poor asset management and tracking. An example of this is the generator failing on an SDH site; this will cause the cooling system to fail and intense overheating which usually results in backbone transmission failing (equipment failure). Within an hour heat buildup becomes so intense that site engineers unable to enter. Hence, a real-time generator monitoring module is also incorporated into the present web application. This real-time generator tracker module is developed using JavaScript and the user interface is shown in Figure 5. The green balloons indicate sites with generators, these are color coded and the functions handling this will change the color of the balloon depending on different criteria, e.g. refuel needed, maintenance needed etc. The balloons blink together with the color changed to red when a fault occurs. This feature tremendously helps the NOC engineers in spotting the anomalies. The menu shown on the figure 5, is a pop up, when the site is clicked. Using this interface, NOC can identify the most nearest site engineer to the fault location and have him sent there for maintenance. In the absence of this interface, engineers have to gather lot of information from Netcool to determine the fault and its location and then the reason behind it. In a way, this application helps the engineers in some of the vital troubleshooting activities too.

The developed application has several screens for user interaction for information exchange. Engineers can determine what is needed for a specific fault condition quickly using this interface. Most important feature of this application is network management and inventory. Engineers can get the information of any device, appropriate substitute or replacement, its availability and the location of most nearest stores. Figure 6 shows a screenshot of user interface for network management.

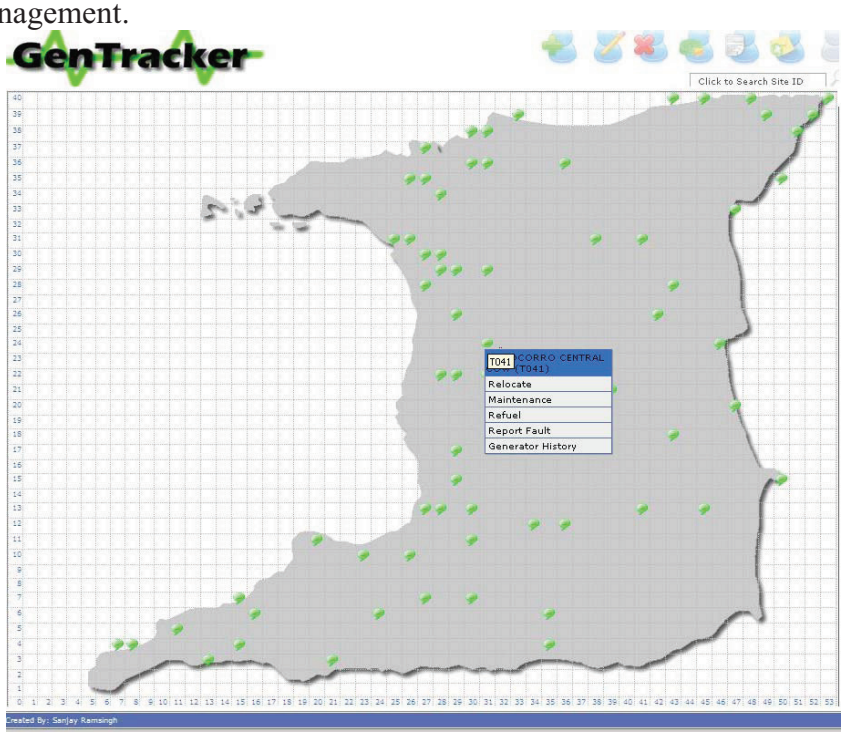

Figure 5. Web-enabled, Real-Time Graphical User Interface for tracking Generators

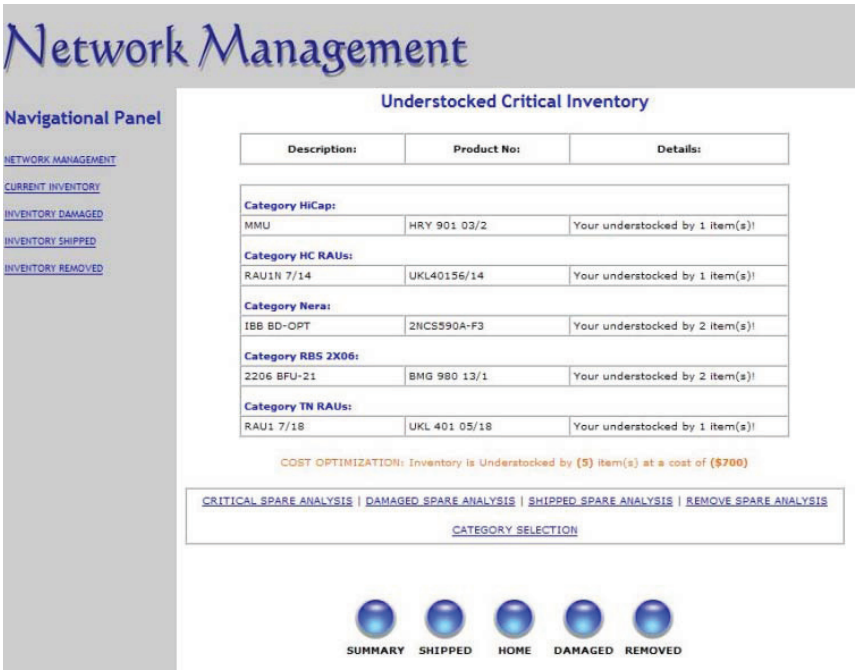

Figure 6. User interface for network management and inventory

Clearly, the nature of mobile communication business is a service providing than anything else. However, the success of the company depends on how well the technology is managed to provide high network availability. Unfortunately customers do not think or care about the 'behind the screen activities' or 'the technical challenges' when they do not see the service. It should be noted that customers measure the performance of any mobile company by two major aspects – high availability of network coverage and attractive tariff structures. When customers do not get what they expect, they normally contact customer service of the mobile company, which is under the control of corporate office. In other words, fault is reported to corporate staff and it is rectified by technical staff. Customer satisfaction cannot be attained by just providing a responsive customer grievance cell, ignoring the technical management part. Modern customers are not really interested in having a dialogue and rather interested in having uninterrupted service. Hence, both corporate and technical units should work hand in hand with common information platform to meet the expectations of the customers.

SUSTAINABILITY

Most mobile companies focus their attention on business operations, expansion of customer base and service quality to survive in the markets. When it comes to developing web enabled asset management systems, often the tendency is to procure a standard asset management packages like Maximo (Maximo, 2008). There are pros and cons to this school of thought. Ready made and well known packages do come off the shelf and appear to be ready-to-use for any typical business environment. Procurement of such products, training the users, product customization for specific requirements, maintenance over a longtime etc are proved to be quite expensive and

yet, the product is not owned by the company. The basic fact is that most asset management products are designed for general purposes and hence a high degree of customization is required. The licensing system of known and popular commercial products may appear competitive initially; however it would be expensive over a long time. In such cases, mobile companies have to be at the mercy of the product vendors for operation, maintenance and especially for customization following changes in company's technologies and components. Even the software companies and suppliers offering such solutions may not be able to support their own older installations due to technological developments, intensions of phasing out older versions, competition in the market, ease of management and their own survival etc.

The attractive aspect of developing an asset management system using license free technologies is very less capital cost, except the cost of application development. Especially when an employee of the company develops the application, the needs and requirements of the various departments will be taken into consideration right from the beginning. It is highly desirable to retain the members of development team in their positions constantly and to train other engineers on the development technologies and with the application to replace outgoing developers if any. Usually it takes 18 to 24 months for any asset management software application in a typical mobile company to understand its effectiveness. Obviously, during this period, management should support the development team morally and professionally so that the application reliability is improved. The two major aspects – application sustainability and process sustainability are discussed below.

APPLICATION SUSTAINABILITY

Application sustainability refers to the efficiency of the application in terms of meeting all the requirements of every department. Application development team is responsible for providing timely solutions, updated versions. The frequency of updates should be less. A new update every six months is fairly accepted. During this window, the development should list out all the problems, new requirements, bugs etc and build a new version. Application sustainability also depends on other factors such as successful adaptation of new versions of operating systems, development platforms, availability of original developers, ability of backup team of developers and database managers, simple yet effective documentation etc.

PROCESS SUSTAINABILITY

Success of company developed, owned typical software applications depend on the factors like - period of effective usage, user friendliness, number of bugs found, average time to fix the bugs, support from the application developers, information and documentation policies of the organization etc. Process sustainability depends on the actual benefits derived out of implementing the application. Ideally the application should help the technical departments in reducing the overall downtime and in carrying out preventive maintenance. To stabilize overall process, management should direct both corporate and technical units to work with the same user interface to get information and to take different decisions. With this approach, all units will report the problems that they experience and communicate to the development team to fix. As the frequency of problem reporting reduces, the general user acceptance increases. Once the

application is time tested and the process is in place over three years without major changes, then it can be termed as sustainable process.

CONCLUSION

Technical activities like network maintenance and management, device trouble shooting and inventory are the major challenging tasks for any mobile communication company. In this work, a comprehensive management information system is designed and developed to automate the overall asset management to achieve higher maintenance efficiency, shorter fault response time and less or no downtime of the services. The unique challenges offered by Caribbean region to mobile operators are presented. It can be seen that such a web-enabled information system is essential to gain the customer confidence and support. Importance of developing such application by the companies is highlighted as opposed to procure generic software products. The factors contributing the sustainability of the developed application are also illustrated.

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AN ANALYSIS OF FACTORS AFFECTING INDUSTRIAL GOODS BUYING DECISION MAKING IN A MANUFACTURING COMPANY

Sallaudin Hassan, Venture Electronics Pte. Ltd., Malaysia
sallaudin@venture.sg
Associate Professor Dr. Abu Bakar Abd Hamid, Universiti Teknologi Malaysia, Malaysia
m-abakar@utm.my
Dr. Chong Siong Choy, Putra International College, Malaysia
scchong@iputra.edu.my

ABSTRACT

The main aim of this research is to determine the factors affecting industrial good buying decision making in a manufacturing company. Specifically, this research is conducted to analyze what are the significant factors affecting the products purchased and supplier selection, the marketing strategies of the suppliers and the influencers involved in product buying decision making. The study also intends to assess the satisfaction levels of the manufacturing company on their current products and suppliers. To fulfil these objectives, a research is conducted on a contract manufacturing company. The analysis is carried out based on new task buying and modified re-buy situations. The respondents consist of engineers with vast experiences in industrial good buying. Data is collected based on a set of self-reporting questionnaire developed. The Statistical Package for Social Sciences (SPSS) software is used to analyze the data obtained. One sample T-Test is used to perform mean score analysis for each of the variables while the analysis of variance (ANOVA) test is used to identify whether there is any significant difference in mean between the selected demographic groups with the significant items identified by the mean comparison analysis for comparison purpose. The results suggest that in product selection, the most significant item for both new task buying and modified re-buy situations is product performance, while product test run availability is the most significant item in supplier selection in both the buying situations. The results also indicate that the most significant marketing strategies in a new task buying situation comprise of product demonstration and test run availability, while the ability of sales representative to convince engineers of the more value provided by a new product or service is the most significant marketing strategy in a modified re-buy situation. It is obvious that the engineering team is dominating the influencer's role in both product and supplier selection in the two buying situations. There appears to be a high satisfaction level among the respondents in terms of the current products purchased and towards their current suppliers. As such, there is a low intention to change the current products used and their suppliers. Practical implications are provided in line of the findings.

Keywords: Industrial goods, purchasing decision making, industrial buyers, supplier selection, industrial marketing strategies, satisfaction levels, manufacturing firm, Malaysia

INTRODUCTION

There is no doubt at all that the industrial sector has been contributing significantly to the economic growth of Malaysia. This is evidenced from the Industrial Production Index (IPI) of the country which rose from 136.3 in 2006 to 144.2 in 2007. As of July 2008, the IPI rose 1.8% year-on-year, after a 2.2% increase in June 2008. The cumulative growth for the period of January to July 2008 was 4.2% over the corresponding period in 2007. The Manufacturing

Index in July 2008 was 1.5% higher compared with the same month in 2007 (Department of Statistics Malaysia, 2008). In line with this growth, the industrial marketing and industrial goods purchasing activities are projected to become increasingly important to support the overall businesses of the sector.

In general terms, industrial marketing refers to the marketing of goods and services to the commercial enterprises which include the manufacturing firms and other non-profit institutions. In turn, these firms reproduce the goods and services for resale to other industrial customers and/or buyers. Among the largest yet significant industrial customers and/or buyers come from the manufacturing sector. These customers and/or buyers buy large volumes of materials such as steel, plastics and aluminium, and component parts such as motors, semiconductor, computers and packaging. In addition, the industrial customers and/or buyers also acquire capital equipments such as machine tools, forklift trucks and laboratory measuring instrument (Corey, 1991).

The industrial customers and/or buyers are responsible for bringing in buying items at the right quality, quantity, time, price, from the right source and deliver them at the right place. In this regard, one aspect in the industrial goods buying decision process that is gaining importance is the selection of suppliers since most firms have been spending considerable amount of their revenues on purchasing (Cebi and Bayraktar, 2003). In fact, Hou and Su (2007) insist that selecting appropriate suppliers is a fundamental issue to fulfill the development strategy of manufacturers. In this respect, a number of supplier selection factors such as their size, geographical locations, technical support, flexibility, and buyer-seller relationships are among the important criteria that warrant significant attention on the part of the industrial purchasers.

At the same time, the decisions made on products purchased and supplier selection are very much affected by the industrial marketing strategies of the suppliers. Price, product performance, promotion, and distribution are important elements which directly impact on the purchasing decision making process. The marketing strategies must be aligned with the buying situation and buying phase so as to attract buyers to start the interaction and therefore opening up the selling opportunity.

The decision making process of industrial goods purchasing is therefore more complicated than often compared to the consumer decision making process. Evaluating and selecting the best offers provided by various suppliers is a complex problem that takes into account tangible and intangible criteria (Kirytopoulos et al., 2008). It usually requires careful consideration from the decision making unit (DMU) or buying centers within the purchasing organization as any mistake may result in revenue losses due to poor product performance from production disruption (Zenz, 1987). Specifically, the DMU plays a major role in providing information and analyzing the suppliers of product types which will subsequently influence purchasing decision making on the part of the firm. The unit may comprise of a number of personnel from different departments within the same firm in which some of them may possess the ability to dominate the decision making process. Besides the identification of the key internal influencers, this study also considers two types of influencers external to the purchasing organization, i.e. customers and competitors which have received very little research attention to date.

Further, it is vital to identify the satisfaction level of the purchasing firms towards the products purchased and the performance of current suppliers. This is because the satisfaction

level closely relates to the degree of intention to change a current product and/or supplier to a new one. Little prior research has looked at the levels of satisfaction and intention to change product and/or supplier from the perspective of the various factors affecting industrial good purchasing decision making process.

As such, this research intends to reveal in detail on the issues related to the industrial goods purchasing decision making process. This covers factors influencing products and supplier selection, the marketing strategies of the suppliers, the influencers within and outside the purchasing firms, the satisfaction levels on the current products purchased as well as on the current suppliers, and subsequently the intention level to change them. In other words, this research intends to achieve the following research objectives:

1. To examine the factors influencing the products purchased and selection of suppliers;
2. To identify the marketing strategies utilized by the suppliers which affect the decision of the industrial goods purchased;
3. To determine the key influencers of products purchased and supplier selection; and
4. To assess the levels of satisfaction and the intention to change the current products and suppliers.

To achieve the above objectives, this research focuses on one contract manufacturing company (CMC) based in the state of Johor, Malaysia. The industrial goods in this research refer to the capital equipments such as machinery, test and measurement equipment, and maintenance tools bought for use in the operations of the CMC. The respondents comprise of engineers who have vast experiences in capital equipment purchasing. This study examines the non-routine buying which consist of new task and modified re-buy situations in the company surveyed rather than the regular buying situations which are handled by the purchasing department. Based upon the statistical results obtained from the 52 engineers surveyed, only the most significant item under each variable is determined and analyzed.

The rest of the paper is organized as follows. The next section reviews literature relevant to the current study. This is followed by describing the methodology used to conduct the analysis. The empirical results are then presented. The subsequent section discusses the findings and their implications. The final section deals with the research limitations and explores avenues for future research.

LITERATURE REVIEW

Definition of Terms

According to Webster (1991), industrial goods and services can be categorized in a variety of ways. A typical scheme involves construction, heavy equipment, light equipment, components and subassemblies, raw materials, process materials, maintenance, repair and operating supplies, and service. Heavy equipment involves large machineries such as machine tools, turbines, supercomputers, locomotives, tugs and barges, and earth-moving equipments.

The industrial customers consist of manufacturing and processing firms (including food, chemical, and petroleum processor) and distributors who purchase goods and resell to other industrial and institutional users (Webster, 1991). Related to this definition, there is a close link between the terminologies of industrial customer and industrial buyer. Industrial buyers purchase goods and services for some tangible, productive, and commercially significant purpose such as the case of the manufacturing industry (Chisnall, 1989).

Besides purchasing materials, the industrial customers and/or buyers also purchase capital equipments (Corey, 1991). However, capital equipment purchasing is complicated by the fact that some products differ among suppliers. Typically each supplier has its own specifications and each product may have slightly different characteristics even in performing the same function. Hough and Ashley (1992) provide a good example where the engineering department of an automobile manufacturer specified the length of forklift trucks. While the users at the plant preferred another brand which was less costly, the purchasing department was mandated to buy according to the specifications established by the engineering department.

Every organization has its purchasing objectives, which are commonly expressed as buying the right items in the right quantity at the right place for delivery at the right time and place. This definition, albeit simple, is rather useful for the identification of the major dimensions of the buyer's problems, product specifications and quality, amount of purchase, price, and delivery. A major function of the procurement unit is to provide continuity in operations by ensuring that the purchased goods and services are available when and where needed. Product quality is another objective of purchasing where quality must be consistent with the specifications developed during the purchasing planning process. The right pricing is another important objective after availability and quality. The objective of the purchasing unit is to develop and receive the necessary services accompanying the purchase of goods such as technical support, application assistance, repair, and maintenance. Another important objective is to develop favorable long term relationships and new sources of supply in order to guarantee the continued availability of goods and services (Webster, 1991).

Buy Classes: Buying Situation

According to Reeder et al. (1991), there are three buying situations. The first one is being the new task buying situation. In such a situation, the problem or need is considerably different from the past experience where problem recognition may be triggered by internal or external factors. For instance, the firm's decision to add a new product line may necessitate the purchase of a new equipment, part or material. A change in customer's requirements may also necessitate the purchase of new machinery in order to meet the changing need. In this situation, the decision makers lack of experience and product knowledge to make comparisons among alternative products and suppliers and they therefore enter into an extensive problem-solving activity. They must obtain a variety of information from various sources to explore alternative solutions adequately before a purchase can be made. In this study, it is posited that the engineering team will be deeply involved in such a situation to purchase new capital equipments. They will be playing a major role in defining specifications and identifying potential vendors before making the final selection.

The second buying situation is modified re-buy. Decision makers enter into this situation when they feel that significant benefits such as quality improvements, enhanced supply and/or cost reduction may be derived at from reevaluating alternatives. More often that not, this situation occurs when the firm is displeased with the performance of its current suppliers which induce such situation to take place. Although well-defined criteria can be used in making such a purchase decision, there is uncertainty on which supplier can best fill the specific needs at the lowest possible switching costs (Primo et al., 2007). In such instances, buyers will attempt to seek additional information. According to Jobber and Lancaster (2000),

modified re-buys often involve engineers, production managers, and purchasing officers with little involvement from the top management.

Straight re-buy is the third and also the most common buying situation. When purchases are continuing or recurring, usually little or no information is required and that routine response is the normal buying pattern. Organizational buyers usually have a set of well-developed criteria that have been used and refined over time. As long as the delivery is prompt, quality consistent, and price is reasonably competitive, a firm is unlikely to reevaluate alternatives and switch suppliers.

Quayle (2001) arrived at an interesting finding where the main factors affecting the switching of suppliers include continuity of supply, importance of achieving price reduction, and importance of security of supply. Items such as lead time, item price, stimulation of competition, market protection, and purchasing power are found to be not significant.

Factors Affecting the Purchasing of Industrial Goods

There are many factors affecting the selection of products to be purchased. In general, they can be classified into several main factors such as the product itself, price, promotion, and place. For years, price has been used as a key determining factor in determining the purchase of goods. To some extent, the notion is supported by Sallauddin's (1999) study. He found that price is the most significant factor, followed by product, promotion, and location. However, studies by Fernandez (1995) and Reeder et al. (1991) refuted this claim. Out of the nine factors surveyed, five factors such as performance, long lasting, repairability, service, and warranty topped the pricing factor. A recent study by Donna and Ramaseshan (2007) on supplier performance confirmed this finding where the influence of price on repurchase intention is insignificant.

Supplier Selection Factors

Prior literature suggests that supplier selection appears to be the most significant variable as it helps in achieving high quality products and customer satisfaction (Gonzalez et al., 2004). It is therefore not uncommon for the industrial customers and/or buyers to evaluate the ability of their suppliers in terms of the delivery of satisfactory quality, quantity, delivery, price, and service objectives which will in turn govern their decisions on supplier selection. According to Leender and Fearon (1991), some of the more important supplier attributes related to these prime purchasing objectives include past history, facilities and technical strengths, financial status, organization and management, reputation, systems, procedural compliance, communication, labor relations, and location.

Besides, buyer-seller relationship has been identified a key factor in the assessment and selection of suppliers especially in the manufacturing sector (Szwejczewski et al., 2005). This is because the success of the relationship has been found to directly and positively affect buyer performance (Kannan and Tan, 2006) in terms of enhanced product quality, better coordination with, and close involvement of suppliers (Jiao et al., 2008; Lau and Goh, 2005). Close relationship with suppliers involves commitment and trust over and extended period of time, characterized by high levels of information exchange, trust, risk, cooperation and/or adaptation, and rewards between the two parties (Deeter-Schmelz and Kennedy, 2004; Herbig and O'Hara, 1994). Buyer-seller interdependence is therefore a hallmark of industrial marketing, particularly in terms of the products used for the operations of industrial

customers. A number of studies have singled out product quality, service capabilities, payment facilities and relationship commitment as some of the most important criteria (Donna and Ramaseshan, 2007; Hsu et al., 2006; Pressey et al., 2007).

Decision Making Units and Multiple Buying Influencers

In organizational buying, the buyer or purchasing officer is often not the only person who influences the decision or who actually has the authority to make the ultimate decision. According to Reeder et al. (1991), the purchasing managers must coordinate with numerous people with diverse organizational responsibilities who apply different criteria when making purchase decisions. The decisions are usually made by a DMU which comprise of a few personnel from different departments such as engineering, purchasing, production, and research and development.

The roles played by these personnel within a DMU can be very substantial in that they influence the purchasing decisions. Among these personnel, however, there exist a fraction of key influencers who are capable of swaying other influencers, either knowingly or unknowingly. Alexander et al. (1956) in their research on 106 industrial firms reveal that three or more persons influenced the buying processes in over 75% of the companies studied. In another study on British engineering firms, Chisnall (1989) discovers that there are more than five influencers in companies with 400 to 1,000 employees and more than six influencers in companies with 1,000 and more employees. This is attributed to the authority, knowledge, and/or information possessed by these key influencers. As such, the ability to identify key buying influencers and sell them the right product attributes is vital to a good marketing strategy (Reeder et al., 1991).

Customer Satisfaction

Whether a customer is satisfied after a purchase depends on the offer's performance in relation to the buyer's expectations. According to Kotler (1997), satisfaction is a person's feelings of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) in relation to customer's expectations. If the performance falls short of expectation, the customer is dissatisfied. If the performance matches the expectations, the customer is satisfied. If the performance exceeds expectations, the customer is highly satisfied or delighted. It is interesting to note that customers who are just satisfied still find it easy to switch when a better offer comes along. However, customers who are highly satisfied are much less ready to switch to either new product or supplier. High satisfaction or delight creates an emotional affinity with the brand, not just a rational preference, which resulting in high customer loyalty.

RESEARCH METHODOLOGY

Research Instrument

Considering the nature of this research and drawing upon prior literature, a set of self-reporting questionnaire was developed for data collection. The questionnaire consists of three parts. Part one consists of four sections. Section one contains seventeen items related to the factors influencing product purchased and supplier selection. The questions on product purchased include product performance, product reliability, long warranty period, product availability, product safety, user friendly, brand, additional packaging, product outlook, and

price. The items on supplier selection comprise of product test run availability, relationship, contact ability, negotiable flexibility, after sales service, established supplier's company, and established local suppliers.

Section two consists of questions capturing the respondents' perception on the marketing strategies pursued by the suppliers of industrial goods. Among the items include product demonstration, understanding the details of customer's problems, impressive details of products or services information, problem solving capacity, maintain dependability, the ability to anticipate problem, test run availability, providing better detailed product, production and service information, established relationship with decision maker, and impressive potential improvement.

Section three comprises of a series of statements aimed at the identification of the most significant influencer to the products purchased and supplier selection. The possible influencers included in this study are the engineering team, quality assurance (QA) team, purchasing team, production team, research and development team. On top of that, external influencers such as customers and competitors are included in the study.

Section four measures the levels of satisfaction of the current products and/or suppliers and the intention to change the current products and/or suppliers. The statements on the current products purchased include product function meets specifications, product supports production productivity, product reliability, price, and safety. Items such as relationship, contactable, delivery performance, after sales services, and promotion package are used to measure the satisfaction level with the current suppliers.

All the questions in the four sections utilized a five-point Likert scale which ranges from 1=very low to 5=very high with 3 scaled as moderate.

Part two captures the respondents' demographic information such as gender, length of service, position, and categories or types of products purchased. Part three consists of a series of open-ended questions soliciting suggestions from respondents on how to improve the current purchasing process and the marketing strategies of suppliers. They are also asked to indicate their general comments, if any.

To establish face validity, the questionnaire was piloted on a few academics and engineers working in the manufacturing sector. The majority of respondents reported that the questionnaire was easily understandable and required only 10 to 15 minutes to complete. Minor changes were incorporated to the final design of the questionnaire based upon the feedback received.

Population and Sampling

This study focuses on Venture Technocom System Pte. Ltd. (popularly known as Venture), a CMC located in the state of Johor, Malaysia. Headquartered in Singapore, Venture is a leading global electronics services provider. Founded in 1984, the group comprises about 40 companies with global clusters in South East Asia, North Asia, America, and Europe, and employs more than 17,000 people worldwide. In 2007, the group achieved sales of USD2.65 billion with annual earnings crossing the USD264 million level for the first time. Top Fortune 500 companies such as Agilent Technologies, HP, IBM, Intermec, as well as other multinational companies have chosen Venture as their strategic partner for their long term

manufacturing needs. These partnerships bear testimony of Venture's relentless pursuit of manufacturing and engineering excellence, continuous innovation, and absolute commitment to quality and delivery, thus meeting today's customer satisfaction. Venture's quality system meets the requirements of international standards such as ISO 9001:2000, ISO 13485, QS 9000, TS 16949, and the FDA Regulation 21 CFR 820. In addition, Venture's certification in ISO 14001:2004 and the ODS (Ozone-Depleting Substances) Scheme is complemented by its expertise in process re-engineering and materials resourcing, which places it in a favorable position to help customers meet RoHS (Restriction of Hazardous Substance) and other international environmental protection standards. The careful selection of the company allows meaningful results to be generated and therefore permits the findings to be benchmarked by other manufacturing companies.

According to Malhotra (1993), population is a large group of individual, object or incidence while sampling is a researched group from the population. In this research, the population comprise of all the staff currently employed by Venture. However, the sample is restricted to engineers who have vast experiences in capital equipment purchasing due to the important roles played by engineers in industrial goods purchasing decision making as described in the literature section (Jobber and Lancaster, 2000). There are 10 departments in Venture which manages the respective projects and/or customers (e.g. Agilent, HP, IBM etc.). Out of the 60 engineers available, 52 from 8 departments agreed to take part in the survey.

Demographic Characteristics

The majority of them are male (44 or 84.6%). This is not surprising, looking at the nature of the profession. The majority of them have worked for Venture for more than five years (51.9%), followed by those between 2 to 5 years (34.6%). Only 7 or 13.5% of them have worked for Venture for less than 2 years. Most of them are test engineers (42.3%), followed by product/process engineers (26.9%), equipment engineers (17.3%) and QA engineers (13.5%). It is apparent that all of them have been involved in the purchasing of capital equipments such as test and measuring equipment (59.6%), maintenance tools (23.1%), and machineries (15.4%) for the company. Only an engineer is involved in the purchasing of other capital equipments (1.9%) not listed in the questionnaire.

Assessing Reliability

To ensure that the items constructed in the questionnaire is reliable, Cronbach's alpha was calculated by using the Statistical Package for Social Sciences (SPSS). A rule of thumb is that 0.60 is the lower level of acceptability for the alpha scores (Nunnally, 1978). Since the reliability coefficient values for all the constructs shown in Table 1 are greater than the guideline of 0.60, the scales are of acceptable reliability and can therefore be applied for further analysis.

Table 1: Reliability Coefficient Results of the Constructs

Constructs	Cronbach's Alpha
Product and supplier selection factor	0.89
Marketing Strategies	0.78
Influencers involves	0.92
Satisfaction level on current product purchased and supplier	0.75

Data Analysis Method

The SPSS is used as the main tool for data analysis. One sample T-test is used to compare and rank the items within each of the variables (product and supplier selection, marketing strategies, and influencers) based on the mean scores in order to determine which item has the highest mean score. The mean score is divided into three categories; low, moderate and high. A mean score of between 1.00 and 2.33 is categorized as low; 2.34 to 3.67 is categorized as moderate while 3.68 to 5.00 is categorized as high. In this study, only the most significant items with the highest mean scores will be analyzed.

In addition to the mean comparison analysis, one-way ANOVA is used to analyze whether there is any significant difference in the mean scores among the different characteristics or groups of respondents with the most significant items identified by the T-Test analyses. Specifically, it is used to achieve the first and forth research objectives, i.e. to test length of service, and position against the variable of product purchased and supplier selection in the two situations, i.e. new and modified re-buy in order to identify the most significant group according to the highest ranked items based on the one sample T-Test results. Similarly, length of service is tested to determine the most significant group in terms of levels of satisfaction and the degree of intention to change the product purchased and supplier selection in the two buying situations based on the highest ranked items as derived from the T-Test analyses. The study concludes that there is a statistically significant difference among the groups if the Sigma value is equal or less than 0.05.

RESULTS

Research Objective 1: Significant Factors Affecting Product and Supplier Selection

The results in Table 2 indicates that in terms of product selection, there is no significant difference in terms of factors affecting product selection in the mean ranking of both the new task and modified re-buy situations. However, product performance has been identified as the highest ranked item in both the new task (mean=4.77) and modified re-buy (mean=4.83) situations. This is followed by product reliability, long warranty period, product availability, product safety, user friendly, brand, additional packaging, product outlook, and price. The ANOVA analysis carried out on length of services and position against product performance (Table 3) shows that there is no significant difference in means for both the buying situations.

In term of supplier selection, product test run availability is found to be the most significant factor in both the buying situations. The mean score for new task buy situation is 4.83 and 4.85 for modified re-buy situation. This is followed by relationship, contact ability, negotiable flexibility, after sales service, established supplier's company, and established local suppliers. The ANOVA analysis was carried out between length of service and position, and product test run availability for both the buying situations. No significant difference was found on new task buying situation, but length of service is found to be significantly different with product test run availability for the modified re-buy situation between engineers who have worked between 2 to 5 years and more than 5 years.

Research Objective 2: Significant Marketing Strategies

The most significant marketing strategy for the new task buy situation is product demonstration (mean=4.62), followed by understanding the details of customer's problems,

impressive details of products or services information, problem solving capacity, maintain dependability, and the ability to anticipate problem. In the modified re-buy situation, the ability of sales representative to convince their customers that a new product or service is able to provide more value is the most significant marketing strategy, followed by providing better detailed product, production and service information, established relationship with decision maker, and impressive potential improvement.

Research Objective 3: Significant Influencers for Products Purchased and Supplier Selection

The findings show that the most significant influencer in both the new task and modified re-buy situations is the engineering team with the mean score of 4.92. In the new task buying situation, the second most significant influencer is customers, followed by the QA, purchasing, competitors, production, and research and development teams. However, the production team plays the second most important role after the engineering team in the modified re-buy situation.

The findings also suggest that the engineering team dominates the supplier selection for both the new task (mean=4.79) and modified re-buy situations (mean=4.83). This is followed by customers, quality assurance, purchasing, competitors, research and development, and production.

Research Objective 4: Satisfaction Level on the Current Products Purchased and Supplier Selection

The results show that the satisfaction level of the respondents is high, judging from the mean score of 4.13. Taking a closer look, the most significant factor contributing to the satisfaction level is that the product function meets the specifications, followed by the support given by the products to production productivity, product reliability, price, and safety. The results also show that the respondents' satisfaction level on their current suppliers is considered high, with a mean score of 3.98. The most significant factor is relationship, followed by contactable, delivery performance, after sales services, and promotion package.

The ANOVA results reveal that there is no significant difference among the different groups of length of service on the satisfaction level with the products purchased. However, significant difference is found with regards to supplier's performance among the engineers who have served Venture between 2 to 5 years and more than 5 years.

Table XX displays the results of the degree of intention to change the current products and suppliers. As expected, the respective mean scores of 1.92 and 2.15 show that the respondents have low intention to switch current products and/or suppliers.

DISCUSSION AND IMPLICATIONS

The first research objective, which is to examine the factors influencing the products purchased and the selection of suppliers, has been achieved. Product performance has been identified as the most significant factor; while price has been ranked the least for both new task and modified re-buy situations. This is consistent with Fernandez (1995) where product performance is the most important item. This finding is not unexpected, looking at the emphasis given by the surveyed company (Venture) to product performance and quality. The

engineers understand that it is only through focusing on performance that guarantees them high productivity and quality which eventually result in higher profitability to Venture.

Price receives the lowest ranking among the ten factors. The finding seems to make sense as the engineers view industrial goods as being purchased for long-term purpose. Lower priced products usually come with lower specifications and therefore, in order to avoid incurring additional costs later on such as cost of repair of machines due to breakdown, the company is willing to spend for better equipments that would also guarantee better quality of products produced. This is also a reason why product performance has been rated the highest. The finding is in line with prior studies where price is not the most important factor in product selection (Fernandez, 1995; Reeder et al., 1991). As such, it can be concluded that price may be an important consideration in the purchase of consumer goods but not to the industrial goods.

Product test run availability has been identified as the most significant factor in supplier selection in both the buying situations. This is probably because the engineers need to conduct an evaluation especially on product performance before justifying the purchase. Relationship has been ranked second highest after product test run availability. The finding is in contrast with prior literature which states that relationship with supplier is the most important factor (Donna and Ramasheshan, 2007; Jobber and Lancaster, 2000; Zenz, 1987). However, the mean scores for relationship for both the buying situations are very close to product test run availability, suggesting that both the factors are considered very important criteria in the selection of suppliers.

The second research objective deals with the identification of the marketing strategies utilized by the suppliers which affect the decision of the industrial goods purchased. In this respect, product demonstration has been found as the most important marketing strategy by the engineers in new buying situations. This is not difficult to understand as the problem or need is novel and the engineers lack of experience and product knowledge. They must obtain a variety of information from various sources before a purchase can be made. In this case, product demonstration is seen as very important because it allows the potential buyer to see, touch and try the product for the product evaluation process. In fact, Jobber and Lancaster (2000) has rightfully remark that detailed information alone without convincing explanation and demonstration does not work in industrial marketing.

The results also draw the attention of suppliers for having knowledgeable and skilled salespersons with the ability to convince the engineers that a new product or service is able to provide more value. This is consistent with the findings of Deeter-Schmelz and Kennedy (2004) who suggest that traditional information sources, including suppliers' salespeople are more useful than even the information provided by the Internet. This makes sense as decision makers usually enter into this situation when they feel that the current supplier no longer able to provide significant benefits to the purchasing organization. While the purchasing company may already possessed a well-defined criteria for making purchase decisions, uncertainty still exists and in many occasions, information is sought from various sources. As such, salespeople who are able to convince the purchasing organization with facts through face-to-face interactions may win the contract.

The third objective is to determine the influencers of products purchased and supplier selection. As expected, the engineering team has been identified as the key influencers in both the products purchased and supplier selection. The findings is consistent with Corey (1991) where engineers play the biggest role in industrial good purchasing because of their

significant involvement in defining the specifications, identifying potential suppliers as well as in making final decisions on the selection of vendors.

This study discovers an interesting finding where customers could be a major influencer to the products purchased by the manufacturer and its selection of suppliers, especially in a new task buying situation. This is not uncommon in the contract manufacturing business model whereby customers frequently intervene in the product selection of the CMC's business as they prefer manufacturers to use recommended products that are recognized by the customer organizations. This is deemed a new contribution of this study as Reeder et al. (1991) do not include customers as a possible influencer to supplier selection. This implies that customers are a new emerging group which has important influence in supplier selection, particularly in a new task buying situation.

In modified re-buy situation, the production team plays a very important role after the engineering team. This is logical as the production team is the user of the products purchased. They are able to compare the current products used with their experience in using prior products and provide feedback. The finding implies that the production team can also become a major influencer in the upgrade or change of product purchased due to their experience and role as users.

The forth objective assesses the satisfaction and the degree of intention to change current products and suppliers. The mean scores suggest that the satisfaction level of the respondents towards the current products and their suppliers is high. The low rating given to pricing confirms the earlier findings that pricing is not a top priority in the selection of products to be purchased. In measuring the supplier's performance, relationship has been identified as the most important indicator of satisfaction. Thus, the notion that relationship with buyer and seller highly contributes to purchaser satisfaction is supported. In fact, Jobber and Lancaster (2000) insist that close relationship with supplier is very important as it will guarantee the reliability of supplies.

The high satisfaction level has resulted in the low intention to change the current products and suppliers. It can thus be concluded that the engineers are satisfied with the current products and suppliers and have no intention to switch. This can be because of their satisfaction with the product functions which meet their specifications and that they have built close relationship with the suppliers. As elucidated by Kotler (1997), high customer satisfaction results in higher loyalty to the products and the suppliers who provide them. The good relationship that both parties are enjoying has prevented the engineers from taking risks to deal with new suppliers and therefore, they will not be significantly affected by the marketing activities of the competitors. Further, as found earlier, the engineers prefer to focus on optimizing the process to improve product performance and productivity.

This study has the following implications for the manufacturing companies and suppliers. This study focuses solely on the engineers and therefore it is not surprising if they view themselves as the most significant influencer in the firm due to the authority, knowledge and information they possess. Future studies should consider respondents from other departments such as QA, purchasing, production, research and development. Nevertheless, the study results convey a clear message that it is imperative for manufacturing companies in general to listen to customers, particularly the CMC. The manufacturing companies ought to strike a balance between their preferred choice of products and/or suppliers and the recommendations given by the customers. Additionally, input from the production team cannot be ignored

especially in the modified re-buy situation. Being the users of the products purchased, the production team is able to provide accurate feedback which guarantees that all the important criteria of product are met.

In addition, this study provides a comprehensive list of factors influencing products purchased and supplier selection which can be of great value to the manufacturing companies. Many researchers have arrived at the same conclusion that using the right strategy for supplier selection and management will ensure the right suppliers who will adequately support the manufacturer in achieving high quality products to meet the needs and satisfaction of customers (Gonzalez et al., 2004; Ndubisi et al., 2005). Specifically, the results of this study allow other manufacturing companies to concentrate on the most important criteria when selecting their suppliers and to develop the right expectations for the products purchased.

Notwithstanding the statistical findings obtained, the open-ended questions have generated a number of useful recommendations for the surveyed company to consider. It is timely for the manufacturing companies to review the current format of industrial product purchasing justification with the aim to overcome the non-uniformity of practice. A proper format allows review by other relevant departments so as to ensure that all the criteria are met. This helps to promote a better review by the management prior to arriving at a final decision. In addition, it is also imperative to think of establishing a centralized industrial goods purchasing system, probably through the implementation of enterprise resource planning (ERP) software systems. Such a system helps in ensuring that all the quotations from the same and/or different suppliers are well coordinated in order to effectively track the transactions (Emiliani et al., 2005). Within the centralized industrial goods purchasing system, consolidation of suppliers' contacts is vital. This would help the engineers in reducing the sourcing time as well as assisting the purchasing department in reducing cost.

From the perspective of suppliers, it is of critical importance that they realign their marketing strategies based on the findings obtained. It is obvious that competing based on price is less relevant in the context of industrial goods purchasing. Instead, value prepositions based on long-term orientation must be emphasized. Customers are looking for products that are able to meet their expectations and specifications. One way to convince the industrial buyers, such as the engineers in this case is by holding product demonstrations and test run availability. By providing engineers with the opportunity to touch, feel, and try the product, this will increase the probability of the product being purchased and the supplier being selected.

In addition, constant communication by means of close interaction and regular visits by suppliers is also imperative in developing and maintaining a good relationship with the manufacturing companies (Ambrose et al., 2008). Pressey et al. (2007) emphasize that the suppliers must realign their competitive strategy and organizational with the buying firm in order to determine the success of the relationship. This encompasses the sharing of information such as the latest product available in the market, sharing of risks possibly in terms of joint investments, design and development and trial runs, and by sharing the rewards gained such as profit, goodwill, and reputation. More importantly, suppliers must attempt to develop trust in the minds of the purchasing organization. Ryu et al. (2008) provide empirical evidence that the manufacturer's perception of a supplier's trustworthy behavior weakens the justification for a higher degree of control and reduces the discontent of supplier's performance. The potential gains from such relationship can be astronomical and can in fact be extended to generating customer's trust and commitment, and ultimately leading to their satisfaction and loyalty (Moliner et al., 2007).

This study also provides an impetus for the suppliers to reconsider their recruitment and selection processes of salespersons to ensure that only those with the appropriate skills, abilities, and knowledge are hired. They must be constantly sent for training and development programs in both the hard as well as soft areas. Hard areas encompass the technical aspects of the equipments they sell so as to enhance their technical knowledge, while soft areas include sales techniques and emotional intelligence required to develop their communication and interpersonal skills which have been proven to influence sales performance (Deeter-Schmelz and Sojka, 2003).

CONCLUSION

This study has successfully achieved all the four research objectives in analyzing the industrial goods purchasing behavior of a selected CMC and the marketing strategies of the suppliers based on new task buy and modified re-buy situations. It adds weight to the argument that an understanding of the factors may guide efforts of the purchasing organizations towards the identification of appropriate suppliers. The suppliers, on the other hand, will be able to determine the preferences of the purchasing organizations and hence use the right marketing strategies targeted at the right influencers to boost the sales of their goods and services.

The findings reported in this study need to be interpreted with caution due to limitations that warrant further research. This study focuses only on a single company which limits the levels of external validity and reliability to analytical generalization (Forslund et al., 2009). A comparison between the CMCs in Malaysia and across geographical boundaries may yield different results. It is also possible for future studies to consider multinational companies (MNCs) and even government linked companies (GLCs). This is in view of the fact that many progressive organizations are now developing proactive supplier-based strategies in order to integrate key suppliers into their processes and systems (Cormican and Cunningham, 2007). Additionally, this study considers two buying situations in the buy classes model (new task and modified re-buy) without directly referring to the straight re-buy buying situation and that only the most significant items are analyzed. In order to generate a holistic picture, future studies should consider comparing the purchasing behaviors in new buy, re-buy and straight re-buy situations across different types of companies and departments using a more comprehensive set of items and rigorous statistical analyses so that all the issues highlighted above can be appropriately addressed.

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INTEGRATED BUSINESS PROCESS AND SERVICE MANAGEMENT

Thomas Gulledge
President, Enterprise Integration, Inc. and Professor Emeritus, George Mason University, USA
thomas.gulledge@eiisolutions.net

ABSTRACT

Service-oriented Architecture (SOA) is typically presented from a software development perspective, viewing the enterprise as an extension of the distributed network management model. The objective of this paper is to demonstrate that the business value of SOA derives from aligning business services with business processes that are enabled as composite applications. This aligned approach to service-oriented implementation is called Business Process Management to SOA (BPM to SOA). The paper describes BPM to SOA in some detail, including an implementation perspective that is based on successful project delivery. The business benefits of BPM to SOA are presented, and the paper asserts that the business case for SOA cannot be completed without aligning business services to end-to-end business processes.

Keywords: Business Process Management, Service-oriented Architecture, Composite Applications

Introduction

Business Process Management (BPM) has received wide attention in the management and engineering literature. Managers, as part of their day-to-day activities, execute procedural logic that is embedded in business processes. Given this fact, it makes sense for managers to execute business process improvement initiatives, such as Lean Six Sigma, Continuous Process Improvement, Total Quality Management, and many others. However, process improvement projects do not always yield the results that were anticipated. The reasons are varied, and many of the critical success factors are documented by Bashein, et al. [1]. However, as noted by Gulledge [8], redesigned processes are only efficient if information flows are supported by systems that align with the redesigned processes. If system realignment does not occur, there is a tendency to revert to the old way of business.

A current trend in the technology literature is Service Oriented Architecture (SOA). SOA means different things to different audiences [12] , but it is only effective it improves the quality of management information [2]. SOA as a technology concept is not very interesting, because managers are not keen to invest in "infrastructure refresh" projects with extended implementation time horizons [15]. SOA must add value to core business processes[1] or it will not be widely implemented.

The primary objective of this paper is to demonstrate that the business value of SOA derives from aligning business services with business processes that are enabled as composite applications. Process innovation is widely accepted as an approach for enhancing business value [4]. If SOA provides flexibility as argued in the literature, then the alignment with

[1] Earl [5] defines core processes as those business processes that add value directly to the customer.

business processes should be a source of process innovation, and hence, directly correlate with the business value of SOA. This primary objective is accomplished by delineating the requisite foundational information on composite applications and linking BPM to SOA.

This paper is not a case study, but we offer the following references for a project that was implemented using the advocated concepts. The project was implemented in a complex Product Lifecycle Management environment in the U.S. Army[2]. The general approach and the requirements definition layer are presented by Gulledge, et al. [11]. An overview of the complete solution is provided by Gulledge, et al. [9]. The details of the case study are not presented in this paper, but these references are provided as supporting empirical evidence. Furthermore, many commercial software providers offer products for implementing the concepts that are described in this paper and contributions of some of the providers are described.

The Basic Concept

A critical assertion is that BPM is a concept that must be understood in any discussions of service orientation. The term BPM is confusing, because it has one meaning for managers and another for technologists. It is necessary to separate the two definitions, and to add clarity, the two definitions are discussed in some detail. The term "Business BPM" is used to represent the manager's definition of BPM, and the term "Technical BPM" represents the technologist's definition of BPM. The concepts are discussed here, but they are covered in more detail in Gulledge [8].

Managers must have a business process orientation. Since business processes define how work is executed, managers are constantly trying to improve business processes in an attempt to increase organizational performance. A typical approach involves interviewing subject matter experts and documenting the business processes for study and analyses. The concept is simple – you cannot improve what you do not understand, so managers are constantly striving for improvement. These management-oriented processes are typically not documented using the technical notation of a system developer or integrator, but are documented in a notation that is comfortable to managers and using common business terminology. Since Business BPM describes how managers desire to execute their business, Business BPM represents the business process requirements of the organization. If the underlying systems do not support these requirements with pertinent information, an "organizational requirements gap" must be filled[3].

Technical BPM is a software concept. It depicts the execution flow as objects (data and code) flow across systems. Technical BPM can be documented in a standard notation, and the most widely accepted standard is the Business Process Execution Language (BPEL). The processes that are documented in BPEL must perfectly align with the Business BPM processes, or business process requirements are not realized. The implication is that Business BPM dominates Technical BPM. Many information system projects are initiated at the Technical BPM level. While such an approach is practical from a technical point-of-view, there is no indication (much less guarantee) that business process requirements (defined by managers) will be realized if the requirements are defined from an IT point-of-view. Figure 1 depicts the

[2] Iyer and Gulledge [13] provide a general description of the environment.
[3] See Gulledge [10] for a discussion of business process oriented gap analysis.

relationship between Business and Technical BPM. Both concepts reflect processes, but their orientation is different. Business BPM is a management approach for documenting, analyzing, improving, and ultimately codifying a set of business process requirements. These requirements are often organized in an integrated repository, and in the form of a Business Process Management Framework.

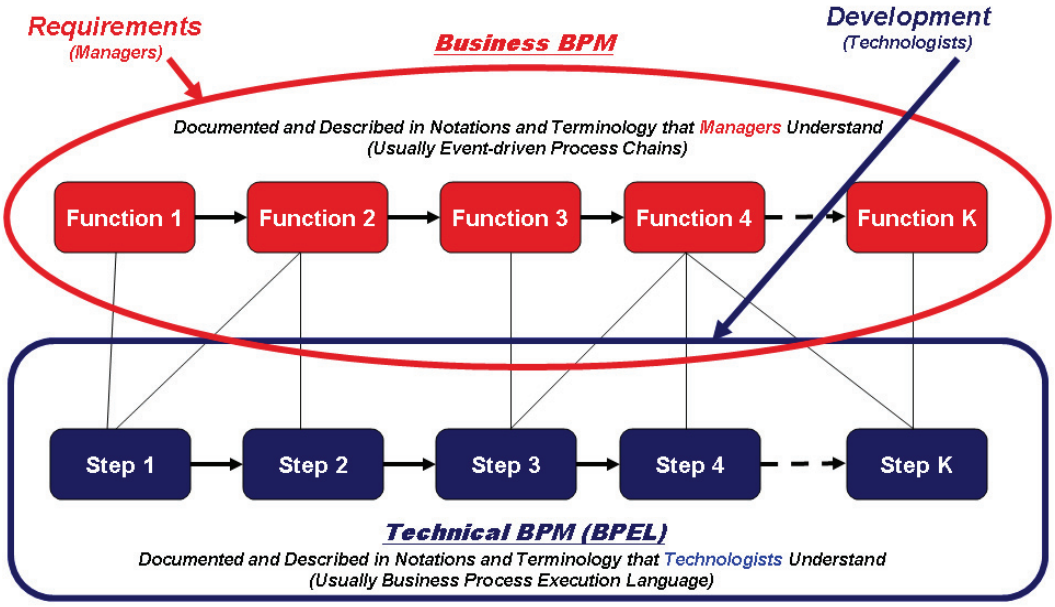


Fig. 1. Business and Technical BPM

As asserted, Technical BPM is a technology approach for documenting the flow of control within or across information systems. Technical BPM must align with Business BPM in order to realize business process requirements. Managers execute Business BPM, and system developers execute Technical BPM; however the two concepts are tightly linked. Managers and technologists must work together while defining and realizing requirements.

Figure 2 presents the concept in an actual implementation that was completed in early 2008.

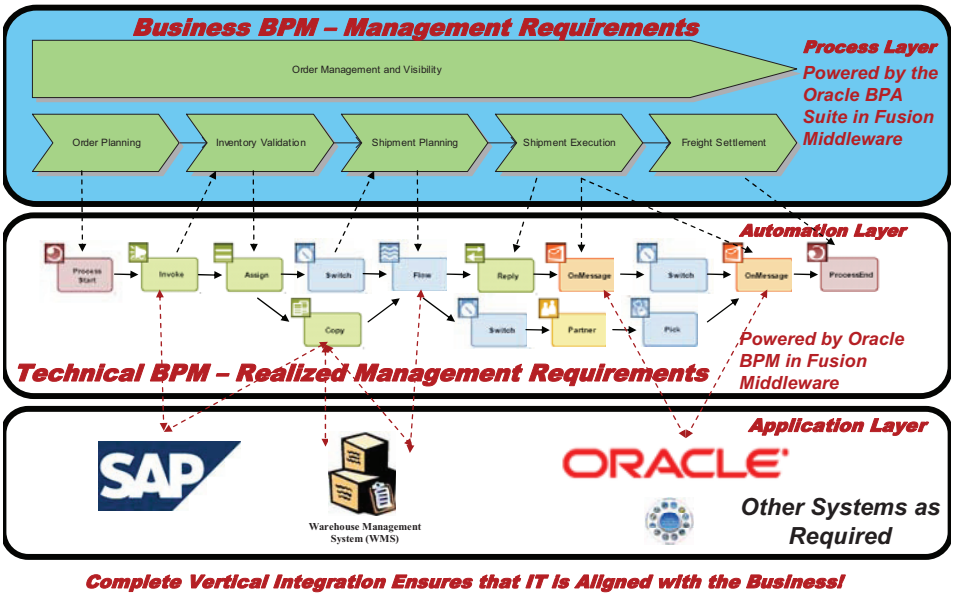


Fig. 2. Business and Technical BPM in a Logistics Order-to-Cash Implementation Project

While the figure is conceptual, it describes the relationship that is more clearly delineated in the subsequent sections of the paper. The organization has one set of desired business processes, and they are documented using a method that is useful for managers. The organization has many systems, and these systems provide information to support the business processes. The top layer of figure 2 represents the business process requirements and the lower level represents the supporting information systems. If the top and bottom are not aligned, the gap must be closed. Technical BPM (center section of Figure 2) provides the linkage between Business BPM and the systems that provide the required information to automate the Business BPM processes.

The Link to Service Orientation

It is noted that Figure 2 is only one view of SOA. Other views are discussed in detail by Gulledge and Deller [12] and are not repeated here. We admit that these different views of SOA are confusing, and a common understanding is difficult, because managers and technologists usually have different views of the business. A complete understanding of SOA requires that all views be understood and reconciled.

However, we assert that the concept in Figure 2 is the most practical for achieving successful service-oriented solutions that directly enable the value-adding processes of the business. This assertion has been noted by the Superplatform vendors[4], and they have responded with products that enable the model described in Figure 2. The distinguishing characteristic of figure 2 is the business process orientated view of service-orientation. That is, the major vendors are taking a business management approach to SOA implementation as opposed to the more technology-oriented view that has emerged in the software engineering community. This is an important point that requires reiteration. The elegance of the technology does not matter if the technology does not add business value. While the technology community may feel that they have made the appropriate business case for SOA, managers are still cautious.

It should also be noted that some of the smaller mid-tier vendors are also providing service-oriented software products, but they are limited in scope and scale. This paper does not describe the details of all the vendors, but we note without reference that all are adopting similar architectures for managing the layers in Figure 2. To explain the architecture and specifically the linkage to business process, any of these vendors could be selected for examination, but we use the Oracle solution as implemented in their Fusion Middleware product to show how BPM can be aligned with SOA and enabled through total business process integration. We select the Oracle solution because Oracle positioned a production solution in the summer of 2007, well ahead of the other vendors, and consequently there has been more time to understand the details of their solution. Other vendors are rapidly closing the gap, but for the purposes of this paper, we selected a single vendor to delineate how a baseline architecture can actually be implemented[5].

The Oracle-specific version of figure 2 is presented in Figure 3, which is reproduced from Scharstein [18].

[4] The superplatform vendors are Oracle, SAP, IBM, Microsoft, and RedHat/JBOSS.
[5] An SAP version of the concept is presented by Stiehl [19]. An IBM view is provided by Ferguson and Stockton [7].

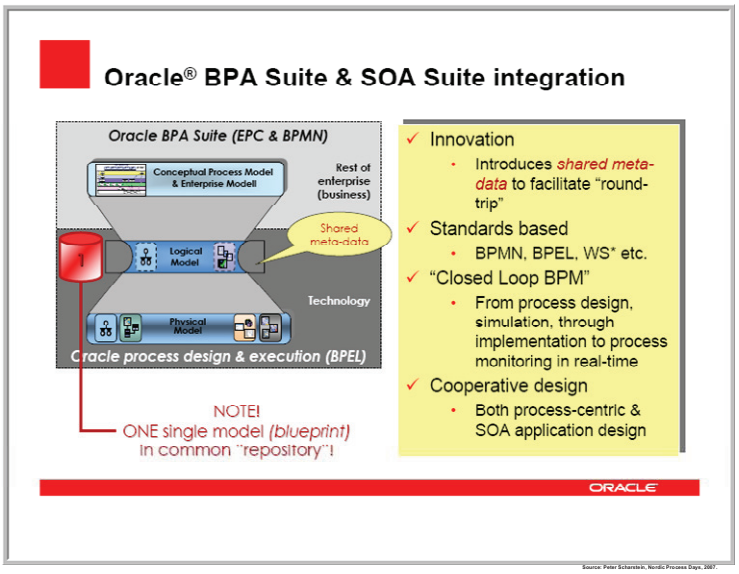


Figure 3: BPM to SOA in Oracle Fusion Middleware

The Oracle solution contains an integrated tool, within Fusion Middleware, for documenting Business BPM using notation that is useful and familiar to managers. Specifically, Oracle supports event-driven process chains (EPCs) or Business Process Management Notation (BPMN). These Business BPM models are automatically converted into a "first cut" Technical BPM layer that Oracle calls the Technical Blueprint. The Technical Blueprint is an automatically generated first draft BPEL model that represents the baseline for the Technical BPM layer. It is important to note that the Technical Blueprint is not executable BPEL, but a "first cut" model that can be converted into executable BPEL.

The Blueprint can be revised and realigned with the Business BPM models, but a one-to-one relationship between the Blueprint and the Business BPM models is always preserved. In the SOA literature, this concept is known as the "round trip." Fusion Middleware manages the linkage between Business and Technical BPM in a single repository. Any number of iterations between business analysts and technical architects can occur before an "implementable" compromise is reached. The important concept is that the relationship between Business BPM and Technical BPM is maintained for each step in the iterative process.

For the next step in the implementation process, the stabilized Blueprint is automatically passed into the Oracle development environment. In this environment services may be developed or discovered for linking to the BPEL models for deployment on the Oracle application server. To create this executable BPEL model, development effort is required, but once again, the one-to-one between Business and Technical BPM at each step of the iterative process is preserved, completing the "round trip." The process is described in detail by Oracle Corporation [17].

The "round trip" implementation is not completely automated (i.e., iterations are required), but it is possible to visualize the early stages of how an executable architecture might be

developed and deployed. At a minimum there is a mechanism for ensuring that business requirements are actually implemented and the process is properly enabled by the systems that fall at a lower level. This is the technical link between service-orientation and Business BPM.

What are the Services that are aligned with Business and Technical BPM Processes?

A service is conveniently described as a small application. Applications are comprised of code (logic), and they must have data in order to execute. For services to communicate with each other, the data must align and communicate though an interface. The situation is depicted in Figure 4.

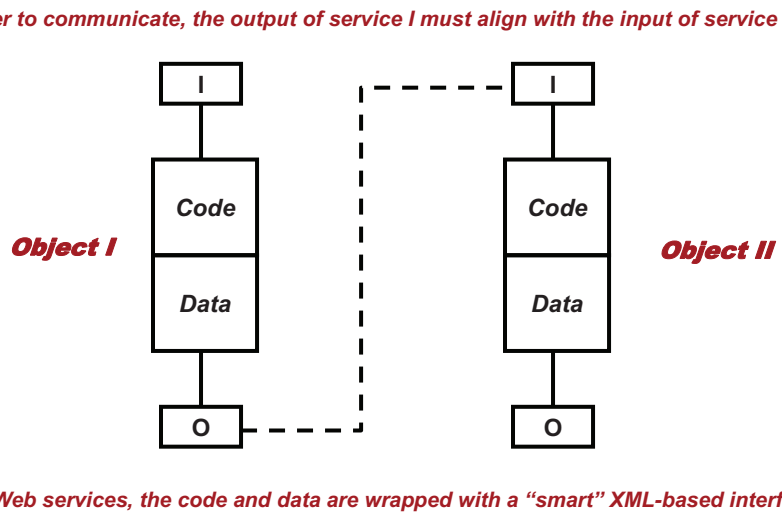


Figure 4: Relationship between Code and Data in Web Services

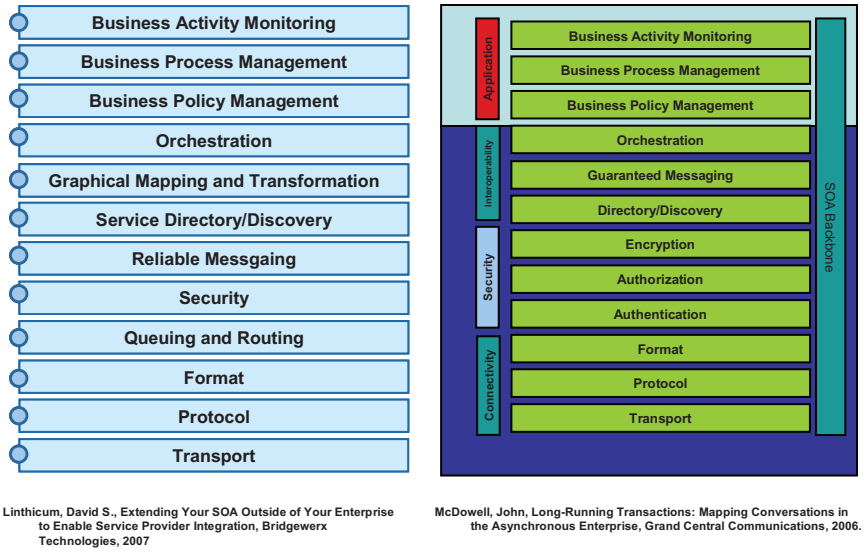
This definition (i.e., services as an application) is consistent with the definition of business services as opposed to technical or infrastructure services. Business services are aggregations of functionality that execute specific business tasks; e.g., process an order, check inventory, etc. A business service may be comprised as an aggregation of technical or infrastructure services, or even as wrapped transactions as with SAP Enterprise Services. The distinction used in this paper is similar to that used by Werth, et al. [20].

Figure 4 also points out the critical role of data as an important characteristic of service interoperability. For the transfer of information in Figure 4, the data must be complete, harmonized, and of high quality[6]. Organizations with fragmented and missing data should initiate a data readiness study prior to considering service-oriented implementation projects, mitigating the risk of failure. That is, one could spend significant resources designing and

[6] Data quality, as referenced in this paper, is a practical concept that is focused on the ability of enterprise applications to have appropriate data to execute in accordance with business requirements. This definition is clarified by Xu, et al. [21].

developing a service-oriented solution, only to discover that the detailed data required to support the application are not available[7].

Service-Oriented Architecture (SOA) is an architecture built around a collection of reusable components (i.e., services) with well-defined interfaces. Services are groups of components that are executed within business processes; for example, verifying a credit card transaction or processing a purchase order. In other words, at the technical level a SOA is a collection of services that communicate with one another. The services are loosely coupled (meaning that an application does not have to know the technical details of another application in order to talk to it), have well-defined and platform-independent interfaces, and are reusable. SOA is a higher level of application development (also referred to as coarse granularity) that, by focusing on business processes and using standard interfaces, helps mask the underlying technical complexity of the IT environment. See the reference by Datz [3]. Figure 5 provides two similar views of Service Oriented Architectures from a technical point-of-view.



Linthicum, David S., Extending Your SOA Outside of Your Enterprise to Enable Service Provider Integration, Bridgewerx Technologies, 2007

McDowell, John, Long-Running Transactions: Mapping Conversations in the Asynchronous Enterprise, Grand Central Communications, 2006.

Figure 5: Two Representations of Service Oriented Architectures

The views in Figure 5 are reproduced from Linthicum [14] and McDowell [16]. While slightly different, the SOAs include all components and standards at a technical level that are necessary to "orchestrate" services into an application. There are a number of SOA reference architectures, and while one could argue about the components, one thing is certain. SOA, as presented in the trade literature, is not in the form of a business process architecture, nor is it presented from a business perspective. This is not a statement of right or wrong, but Figure 5 presents two typical presentations of SOA. In both cases, the architecture is presented from a technical point-of-view. Technical BPM is the highest level in both architecture presentations. In Fact, figure 5 is a software developer's view of the enterprise that applies the basic concepts of distributed networking to the management of enterprise objects. By and

[7] It is noted that an enterprise wide data model is not required to implement composite applications; a canonical data model is sufficient. The canonical model can be expanded as additional processes are implemented,

large the IT literature addresses the technical aspects of service orchestration, but not the business aspects. This lack of a business view is what distinguishes some interpretations of SOA from the business process-oriented approach that is presented in this paper.

The implications are paramount. Before the technology view of SOA will be widely accepted by management, SOA models similar to those in Figure 5 must be aligned with management's orientation, which is the execution of end-to-end business processes that add value to the customer. Otherwise, SOA implementation will always be viewed as a costly technology project that is focused on infrastructure refresh, and such a "refresh model" cannot be easily reconciled with customer value-adding processes.

Implementing from the Technical Level

Many companies provide solutions for implementing Technical BPM. That is, the Business BPM requirements could be ignored and one could directly implement from a BPEL representation of the Technical BPM. This is certainly possible, and many implementation projects are initiated at this level. However, there is evidence that this implementation approach is not preferred. Table 1 contains data from a recent study reported by Ellis [6].

Joint Ownership of Requirements is Most Effective

Who Owned Primary Responsibility for Requirements?	Budget % of target	Time % of target	Functionality % of Target	Stakeholder time % of Target
IT Organization	162.9	172.0	91.4	172.9
Non-IT Business	196.5	245.3	110.1	201.3
Jointly Owned	143.4	159.3	103.7	163.4

N=109
Source: IAG Business Analysis Benchmark, 2008

Table 1: Diagnosing Requirements Failure [6]

A quick analysis of Table 1 indicates that none of the data are encouraging; a sure indication that a requirements gap does exist. If the IT organization or non-IT business owns the requirements, overruns are prevalent. The numbers are slightly better when the IT organization owns the requirements, which is logical. The IT organization knows the "easiest path to deployment," and the requirements are tailored to leverage this knowledge. The striking characteristic of Table 1, however, is that when the requirements are jointly owned, the numbers are improved in all categories.

One research study is insufficient to draw conclusions, but from a practical point of view one would expect the outcome that is presented in Table 1. Furthermore, Joint Ownership is a requirement for aligning Business BPM with Technical BPM while preserving the "round trip."

The BPM to SOA Implementation Process

To formalize the theoretical relationships advanced in this paper, an implementation roadmap that has been effectively developed, documented, and implemented at the project level is presented. This model has been refined over a two-year period by researchers at Leonardo Consulting (Australia) and Enterprise Integration, Inc (USA). The roadmap combines an implementation methodology with a project planning structure to provide an approach to implementing Business BPM processes that are enabled by business services from multiple information systems. An overview of the roadmap is presented in Figure 6.

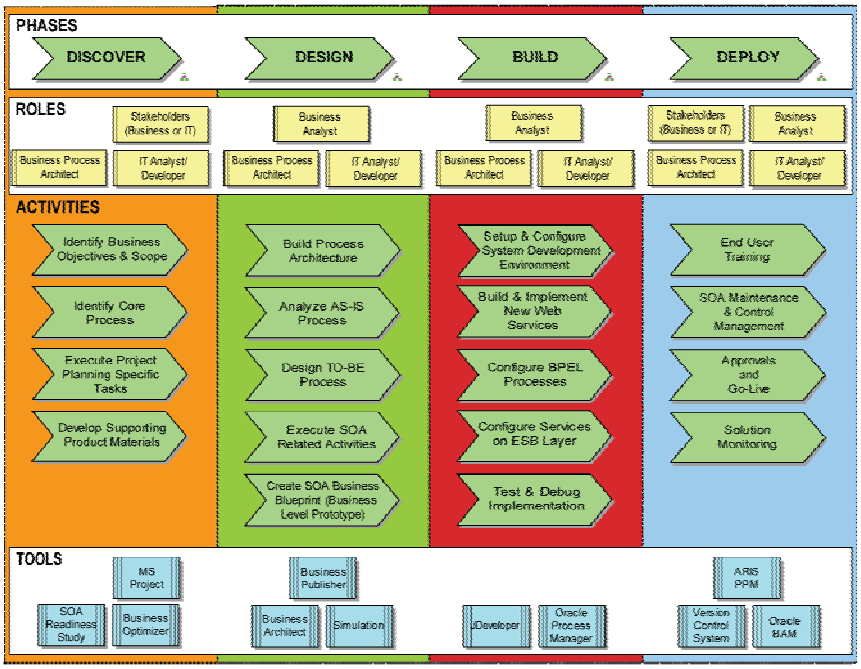


Figure 6: Overview of BPM to SOA Implementation Roadmap

The roadmap is organized around a lifecycle model – discover, design, build, and deploy. Within this model certain activities have to be performed, and the activities must be divided between technologists and managers. Each high level chevron in Figure 6 is decomposable into more granular tasks. For example, Figure 7 provides a decomposition of the design phase.

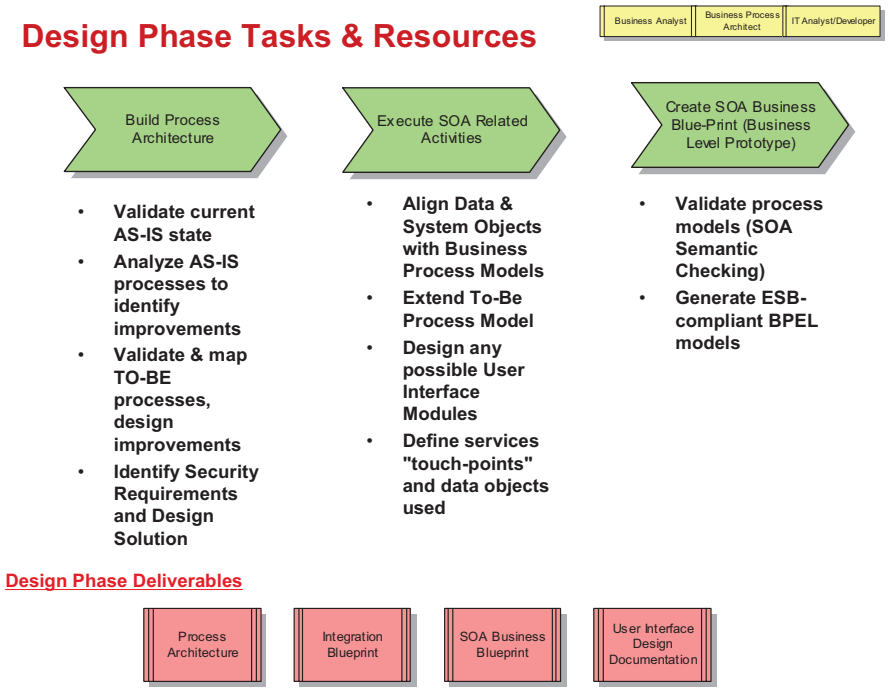


Figure 7: Design Phase Decomposition for BPM to SOA Roadmap

Space will not permit a detailed analysis of every step in every phase, but the point is that there is a well-defined roadmap that when properly followed does lead to successful implementation. An overview from a different perspective is presented in Figure 8.

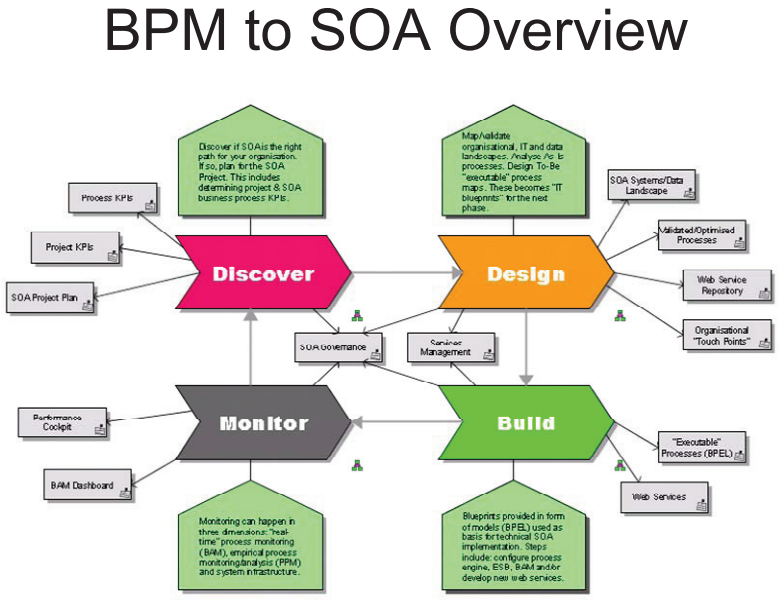


Figure 8: BPM to SOA Overview from a Network Perspective

If the roadmap is followed, the implementation structure is hierarchical with Business BPM providing the requirements for the deployment at the implementation level. The linkage that

aligns the business BPM requirements with the deployed solution is the Technical BPM layer. These linkages are from Business BPM to deployment as depicted in Figure 9.

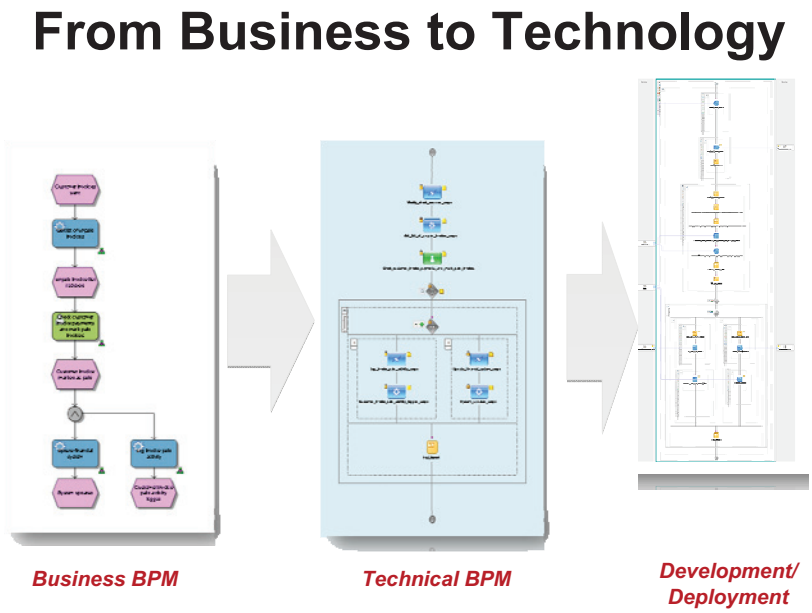


Figure 9: Transition from Business BPM to Service-oriented Development and Deployment

The relative positioning in the hierarchy can be described in a simple governance model as presented in Figure 10.

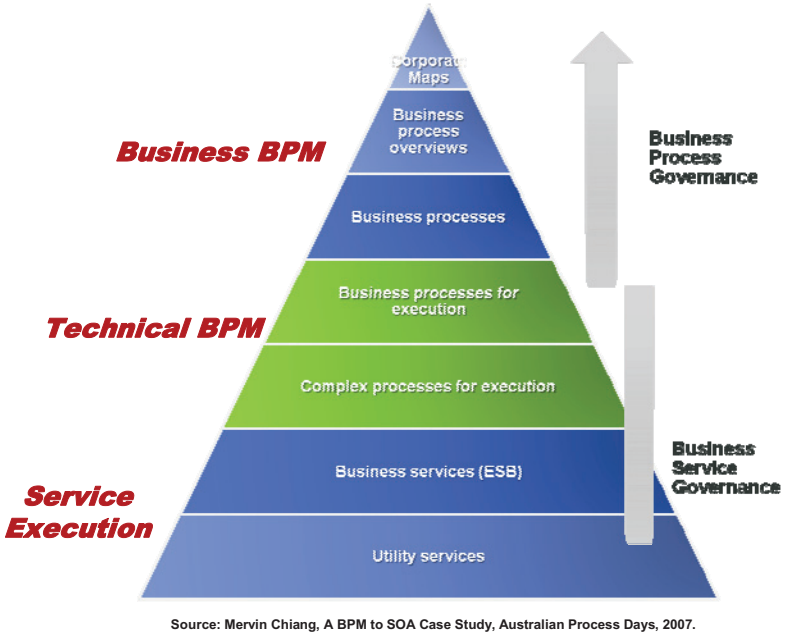


Figure 10: Layered Architecture that Aligns BPM with Service Execution

The model requires business process governance at the business requirements level and business service governance and the execution level. The round trip is completely preserved by this model and business requirements are completely aligned with technology requirements.

Review and Analysis

As a review, it is noted that this model is only one view of SOA. Gulledge and Deller [12] presented three possible views, and BPM to SOA represents only one of those views. Our assertion is that this view is more closely aligned with management activities than other views, and this assertion is biased by a strong belief that IT projects should support business outcomes.

BPM to SOA falls into a general class of solutions that is known as composite applications. We have extended the literature on composite applications through project implementation and the development of top-to-bottom implementation roadmap. The assertion is that there is a successful path to business-value-adding SOA though composite applications as described in this paper.

The key concept is the alignment of a three-layered model that is characterized by:

- Business process requirements as modeled in a Business BPM layer,
- Technical business process and flow control as modeled in a Technical BPM layer, and
- A service execution and deployment layer (as implemented in a modern SOA Suite such as Oracle Fusion Middleware) that consumes services from multiple information systems.

The benefits of BPM to SOA are numerous. These are some of the most obvious benefits:

- Business process requirements are aligned with system implementation requirements.
- The composite application structure provides a framework for executing the SOA round trip to rapidly realign business processes to accommodate changing requirements, as indicated in Oracle Corporation [17].
- The solution is deployed using state-of-the art SOA methodologies and technologies.
- The solution is complete and integrated.
    - Business and Technical BPM are managed in a single implementation environment without complex interfacing and synchronization across the layers.
- The business processes, defined in management terms, provide “control” over the technology landscape.
    - Since the middleware provides top-to-bottom integration, one can have confidence that end-to-end business processes are actually implemented in accordance with business requirements.
    - Technologists have confidence that they are developing and deploying in accordance with business requirements.
- All aspects of the solution are standards based, and the solution accommodates services provided by any vendor that adheres to the WS-* standards.

- The solution allows for the reuse of existing services or the development of new services.
- The solution allow for BPEL segmentation for reuse.
- The solution allows for canonical data model extensions are reuse.
- The architecture leverages the investment in existing systems
- No one vendor dominates the technology landscape.
    - This is consistent with the technology landscape in most large organizations
- Implementation does not require a "big bang" approach.
    - The deployment is on a process-by-process basis. This characteristic allows one to begin with smaller initiatives while moving to larger initiatives as experience matures.

The documentation and analyses of these derived benefits are the foci of our ongoing research efforts.

Conclusions

Service-orientation can be presented within a distributed network management framework, but at risk of overlooking the true value of SOA to the business. Managers are focused on the execution of end-to-end business processes that add customer value. If SOA can enable these business processes with higher quality and more timely information, then the business value of SOA is defined.

This paper presents a composite application approach for aligning a service-oriented model with value-adding business processes. The approach can be implemented using multiple vendor product suites, and the implementation roadmap is defined and documented in a procedural model.

BPM to SOA supports the complete alignment of business requirements to implemented processes in a round trip model. This structure generates many benefits over and above traditional approaches to aligning requirements with implementation projects. While manual intervention is still required, it is clear that the system implementation landscape is evolving to a new paradigm. The old paradigm was characterized by an enterprise architecture that is not formally aligned with implemented systems. Therefore, plans that are documented in the architecture are seldom realized at the implementation level. With an executable architecture, the plan is directly linked to the implementation layer, ensuring that business requirements are realized.

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Analyzing gaps for ERP introduction: An adoptive learning model

Shing-Jen Song, National Cheng Kung University, Taiwan.

ABSTRACT

Confronting with internal and external changes of business environment, enterprise seeks for improvement of efficiency and competitive advantage. Due to the progress of information technology and competition of production management, business processes needed to be reformed or expanded in right time and right way. Enterprise resource planning (ERP) system is one of the most widely accepted choices to obtain competitive advantage for manufacturing companies. Although the failure rates of these ERP implementations have been highly publicized, this has not kept companies from implementing ERP systems. The gaps for ERP introduction need to be deeply and thoroughly surveyed in both qualitative and quantitative approaches.

By qualitative approach, deeply reviewed many cases and content analyzed, we derived two new conceptual dimensions i.e. information technology capability and general management capability. Our adoptive learning model can be used to assess gaps when introduce a new production management strategy. By using system dynamics method, we quantitatively check the dynamics for the introduction gaps of ERP systems. This new framework proposed here provides insights for improvement and increasing the competitiveness of an organization.

Keywords: ERP; Gaps; Qualitative Research; Capability; System dynamics; Adoptive Learning.

INTRODUCTION

To obtain competitive advantage for manufacturing companies in a dynamic complex global environment, enterprises seek for new operations management system to increase their efficiency and profitability. The major evolution of production management systems in the late twentieth century evolves from Material Requirement Planning (MRP), Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems. In the 1970s, Joseph Orlicky as well as others like George Plossl and Oliver Wight shared a common vision of educating the world to the usefulness of MRP system. They redirected the way inventory management was taught in the classroom and even researched Mabert (2007).

In the 1990s the market was driven by consumers demand, and therefore the production life cycle became shorter and shorter. The diverse and instant customer demand had also

accelerated the elimination of business if it failed to respond rapidly. In the trend of globalization, enterprises had to integrate message from different places and information from all over the world so that they could exalt the synergies. The MRP system was obviously not capable of dealing with the rapid, diverse, and global business model. To cope with the need, the ERP system provides integrated messages across the departments and regions with instant information for decision support.

For information technology those days could not meet managers' expectation, Enterprise Resource Planning (ERP) system has been promoted by the American Production and Inventory Control Society (APICS) in the 1980's by extending the Manufacturing Requirements Planning. In 1990s, Enterprise Resource Planning (ERP) systems have evolved with IT as an enabling technology, which integrates various functional (operations, marketing, finance, materials, human resources etc.) information systems into a seamless suite of business applications across the company and thereby, allowed for streamlined processing of business data and cross-functional integration.

In a global competitive environment, information and production flow had no longer independent among enterprises. The relationship between enterprises had formed a so called Supply Chain Relationship (suppliers- manufacturers-customers). Integration inside the supply chain had been enthusiastically promoted among enterprises, for integration can substantially reduce production cost, manufacturing cycle and quick response to customer demand. The ERP system truly provides foundation stones for Supply Chain Management (SCM) and the importance of a successful ERP system introduction can be easily perceived.

Research design

Researchers often use qualitative methodologies to explore, analysis and identify important categories in the material with the aim of generating ideas and theory 'grounded' in the data (Rennie et al., 1988; Charmaz,1995; Henwood and Pidgeon,1996; Charlotte, 2005). In quantitative research, researchers use statistical procedures and generalizations to determine what data mean, whereas qualitative researchers use phenomenological techniques to extract meaning. Both quantitative and qualitative paradigms attempt to reduce the dimensionality of their data. In quantitative paradigm, data-reduction methods such as factors analysis and cluster analysis are analogous to thematic analyses conducted by qualitative paradigm researchers (Onwuegbuzie, 2003).

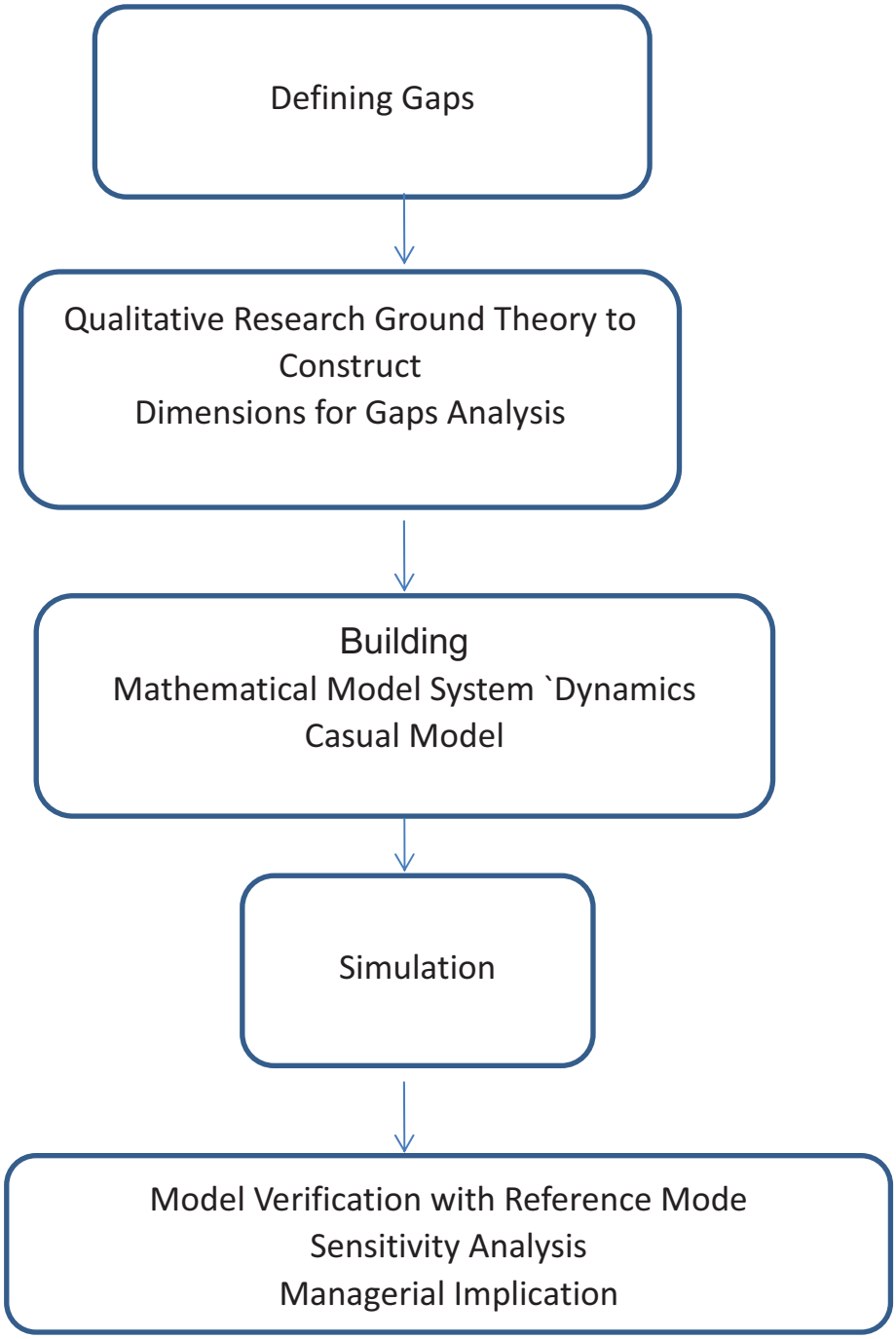
Abound similarities between quantitative and qualitative research, we are not confined ourselves to quantitative research and therefore we verify part of our results with qualitative

research conducted by Lin (Unpublished paper founded by National Science Council, Taiwan, R.O.C) to enrich methodological pluralism and to justify our research result. Lin and his research group selected 14 Taiwan's firms including high-tech industries as well as traditional manufacturing industries to analyze the impacts of information technology capability and general management capability during the introduction of ERP.

Following Kvale's(1996) in-depth interview process i.e. thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting procedures, we validate our interview finding by triangulation method. By using a grounded theory approach, developed by Glaser and Strauss (1967), we keep a research diary and memo writing throughout the research process with a line by line coding of the written text, identifying descriptive categories which are constantly compared for similarities and differences. These data were analyzed line by line, and all words or clauses carrying meaning were given substantive codes. These in turn are clustered or merged in order to construct researcher categories at a more conceptual and interpretive level. In the end, we compare both quantitative and qualitative result to verify our conceptual models which lead the general factors (stocks).

System dynamics is a powerful tool in the creation of feedback theories. Since its beginnings, the founders of the field have developed a series of guidelines for the model building process (Randers 1980; Richardson and Pugh 1981; Roberts *et al.* 1983; Wolstenholme 1990; Sterman 2000) and a series of tests to build confidence in the models created (Forrester and Senge 1980; Sterman 2000). (from Luis Felipe Luna-Reyes* and Deborah Lines Andersen)

Many researchers have studied the critical or risk factors which affect the induction and implementation of ERP system. Few were discussed for the dynamics between factors in a real world with feedback system. For a better understanding, based on Prof. Lin and his research group's qualitative research, we try to use system dynamics theory through both quantitative and qualitative approaches to investigate the gaps during ERP introduction.



Literature review and Conceptual Model

Although the failure rates of these ERP implementations have been highly publicized, this has not kept companies from investing large money on ERP systems. Bingi et al. (1999), Laughlin (1999), Hong and Kim(2002), Berchet and Habchi(2005) had studied the success factors in ERP implementations. While identifying risks can be a challenge for managers, especially because there are different ways in which they can be described and categorized (Baccarini et al. 2004). On the other hand, often terms such as ‘‘Risk Factors’’, ‘‘Critical Success Factors’’ and ‘‘Uncertainty Factors’’ are usually conveyed the same concept. Aloini

et al.(2007) homogenized all these factors and grouped them into similar factors.

ERP implementation process

Umble *et al*. (2003) suggest the following ERP implementation procedures : (1) in the selection phase, select the ERP system, make sure that the hardware meets demands, and install the system with the help of qualified personnel; (2) in the subsequent system training phase, start from single transactions, and proceed thereafter to company-wide processes; (3) provide users with appropriate permissions and ensure system security; (4) ensure that data brought from previous systems are accurate and users have the ability to use it; (5) bring the system online; (6) celebrate the implementation results; and (7) continuously improve system utilization.

Our study described here is primarily drawn from the process-oriented approach because the underlying presuppositions of the study is that gap information gained from user evaluations can be applied to improve an ERP system which has already been implemented, thus underlying time related dynamics can be discussed. However, related causal linkages may trace back to critical factors, for example, the ERP selection, ERP performance and human resource issues.

Risk factors identification and description

According to Aloini et al.(2007) , the main ERP implementation risk effects were identified from the literature: budged exceed, time exceed, project stop, poor business performances, inadequate system reliability and stability, low organizational process fitting, low user friendliness, low degree of integration and flexibility, low strategic goals fitting and bad financial/economic performances. From literature review of risk factors, one can roughly categorize risk factors into information technology and general management capabilities.

Empirical studies for ERP introduction factors

Ehie and Madsen (2005) empirically studied the critical issues which affected the successful implementation of ERP systems by conducting 200 questionnaires in the Midwestern of the USA. The survey suggested key factors are project management principles (accounted for 20.95% of the variance), feasibility and evaluation of ERP project in the firm (12.81%), top management support (9.48%), business process reengineering(8.60%), consulting services (8.03%), and cost/budget issues (8.28%).

Although some companies such as Cisco Systems, Eastman Kodak, and Textronix have reaped the expected benefits of ERP systems; on the other hand, many businesses are discovering that their ERP implementation is a nightmare. There were many papers on the processes of ERP implementation. Yahaya et al. (2004) conducted at Rolls-Royce, a global business offering a range of first class world leading products over 14 different countries, to investigate the implementation of ERP (SAP). They had discovered some of the problems encountered during the induction of ERP, such as matching the process to the software configuration, training people to accept change, getting people to do business in a totally new way, teaching employees to use modern IT equipment, equipment not delivered on time, delays in technical equipment installation, time consuming as many legacy systems have been involved etc.

In order to investigate the success or effectiveness of ERP system, Chien and Tsaur (2007) collected data from questionnaires answered by 204 users of ERP systems at three high-tech firms in Taiwan. In this study, they suggested that system quality, service quality, and information quality are most important successful factors.

Developing countries faced more challenges of implementing ERP system from developed countries; there are gaps in the ERP literature that needs more research attention. Especially firms in developing countries like China and Taiwan are usually much smaller than those developed countries in Europe and North America. Small and medium-sized enterprises (SMEs) faced gaps while they trying to implement Enterprise Systems (ES). Previous researches showed that poor schedule estimates, uncertainty about the ERP implementation timeframe (Martin, 1998), weaknesses in both IT infrastructure and IT human resources (Liu and Zhou, 2001), difficulties in transition to new systems, unavailability of skilled people, and high turnover of key project persons Tsai et al. (2005) were commonly encountered gaps.

The Conceptual ERP Success Framework and Defining for Adoption Gaps

Based on the empirical ERP success factor literature and the IS research model proposed by DeLone & McLean (1992; 2003)' IS success model the dependent variables that measure ERP implementation success are defined.

(1) System quality: The desired characteristics of an IS itself.
(2) Information quality: The desired characteristics of the product of an IS.
(3) Use: The receipt consumption of the product of an IS.
(4) User satisfaction: The receipt response to the use of the product of an IS.
(5) Individual impact: The effect of information on the behavior of a receipt.
(6) Organizational impact: The effect of information on organizational performance.

From DeLone & McLean concept of success, we define ERP adoption gaps as the percentage discrepancy of cumulated success to achieve both users' satisfaction and intention to use. Since firms usually adopt ERP system by using project management skills and by creating serious of Work Breakdown Structure (WBS). The lowest level of WBS is called work package which involves a short term task with precise starting point, needed resources, budget and a check point. Each manager of work package takes responsibility to check whether its function and performance meets requirements. The total succeed performance of ERP is gradually accumulated, evaluated and reported to the top management. Thus, a feed back loop system is created.

ERP Absorptive Capacity

The learning perspective suggests that assimilation can be greatly improved if organizations have prior knowledge that facilitates assimilation of external information and its application to commercial ends (Cohen and Levinthal 1990). This ability is termed *absorptive capacity* and is widely understood to enhance an organization's innovative capabilities.

Scholars (Cohen and Levinthal, 1989b) have discussed the character of absorptive capacity and its role in assimilating and exploiting effects of learning. We suggest a simple generalization that applies at both the individual and organizational levels: prior IT and management learning experience permits the assimilation and exploitation of new adoption capabilities. Some portion of those prior capabilities should be very closely related to the new adoption capability to enable assimilation for new ERP function. Some fraction of that capability must be fairly diverse to daily workload for production, may however closely related, to improve the effective, creative utilization of the new ERP system.

In 1936, the first documented learning curve was published by Wright (1936) who had observed that unit production costs of an aircraft manufacture declined with cumulative output. Levy (1965) presents a new type of learning function useful in describing how firms improve their performances in new processes. The function, termed the "adaptation function," is shown to be capable of being related to variables that may affect a firm's rate of learning. Base on this research we propose that information technology capability and general management capability are the main factors which dominate the adoption of ERP system.

Argote et al. (1990) suggest that learning is a powerful source of productivity which enhances manufacturing performance. Learning rate may vary from different organizations, firms and business. Cohen and Levinthal (1990) also suggested a new perspective on learning and

innovation. These prior knowledge underlies absorptive capacity has important implications for the development of absorptive capacity over time and, in turn, the evaluation of ERP performance could be done.

Casual Loop Diagrams for ERP Adoption Factors

In real world, we might think imagine that there must be lots of different behaviors to account for the feed back structures. However, experts find that most dynamics in nature or social science are instances of a small number of distinct patterns of behaviors, such as exponential growth, oscillation or S-shape.

Feedback is one of the most important concepts in management. Yet very few researches have been discussed the critical feedbacks and system dynamics for the GAP while introduction of ERP system. Researchers often use statistics methods to investigate casual relationships between variables such as regression, factor analysis or structure equation modeling (SEM).

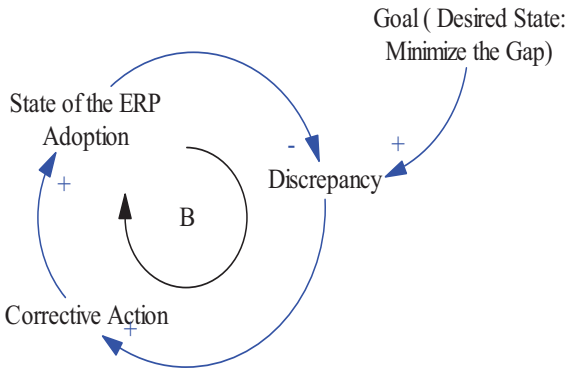
However, these methods usually depend on correlations and linearity among variables. Correlations do not represent the structure and dynamics of the underline system. To investigate the, we use system dynamics method and try to model the behavior pattern and factors which affect the success of ERP introduction.

Controlling Feedback View for ERP

In a view of controlling feedback model, we focus on the gaps information processing procedures. An ERP project performance is typically measured in terms of schedule, cost, quality, and scope. Management actions to control a project's performance are modeled as efforts to close the target performance gap in one or more performance dimensions. The two basic methods available to ERP practicing project managers have been modeled: move project behavior closer to general management targets, or move targets toward IT project behavior. Both methods use negative (controlling) feedback loops, with managerial responses typically being proportional to gap size. Since the adoption of ERP system is not unique to a business, we define the true success of an ERP system requires both success for IT and management. However, limits do exist on the rate of adoption and both methods impose costs (monetary, work hours and other types). We use an aggregate concept involvement to represent the degree a firm and their employees who willing to devote their resources on the ERP project. To realize this concept, we use workload devotion to represent the portion of work hours that a firm (employees) willing to improve the gaps.

Negative Feedbacks and Causal Loop Diagrams

Notice that the goal of a firm is to successfully adopt an ERP system, and therefore devote a faction of their resource (time, IT and management capabilities) to reduce the gap. In this manner, it forms a balancing loop and a goal seeking structure. Negative feedback loops act to bring the state of the ERP adoption process in line with a desired state. In the adoption process, negative feedback loops counteract any disturbance that move the state of the adoption process away from the goal.



For better understanding of our model, we aggregate our model to a simple causal relationship i.e. adoption rate and adoption gap (Figure1) . In this diagram, we focus only the simple relationship between adoption gap of ERP and the rate of adoption. Since we know that only a small portion of our efforts can increase the adoption rate which help to minimize the ERP adoption gaps.

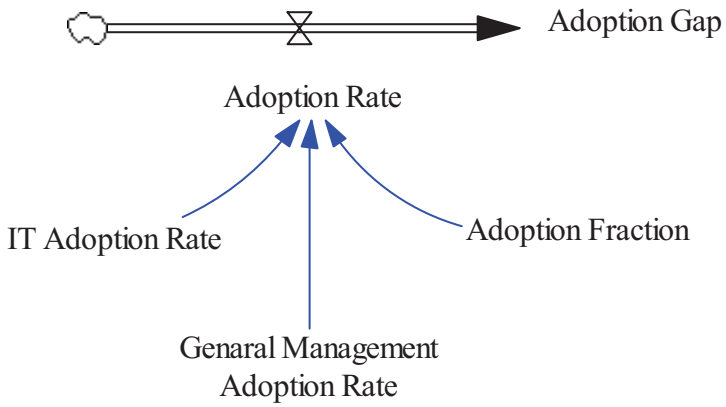


Figure 1

Causal loop diagrams (CLDs) are an important tool for representing the feedback structure of systems. A fundamental causal loop for analyzing gaps in the ERP introduction can be modeled as figure 2. The general aggregated relationships shown in Figure 2 provided the basis for further development of specific cause-and-effect relationships for the ERP adoption processes. The causal structure process is shown in detail in Figure **3.** In posing such structural models, the hypothesized causal relationships between system elements are specified by considering two elements, one at a time. The + or - sign on the arrow indicates the hypothesized direction of movement taken by the response variable when the first variable increases.

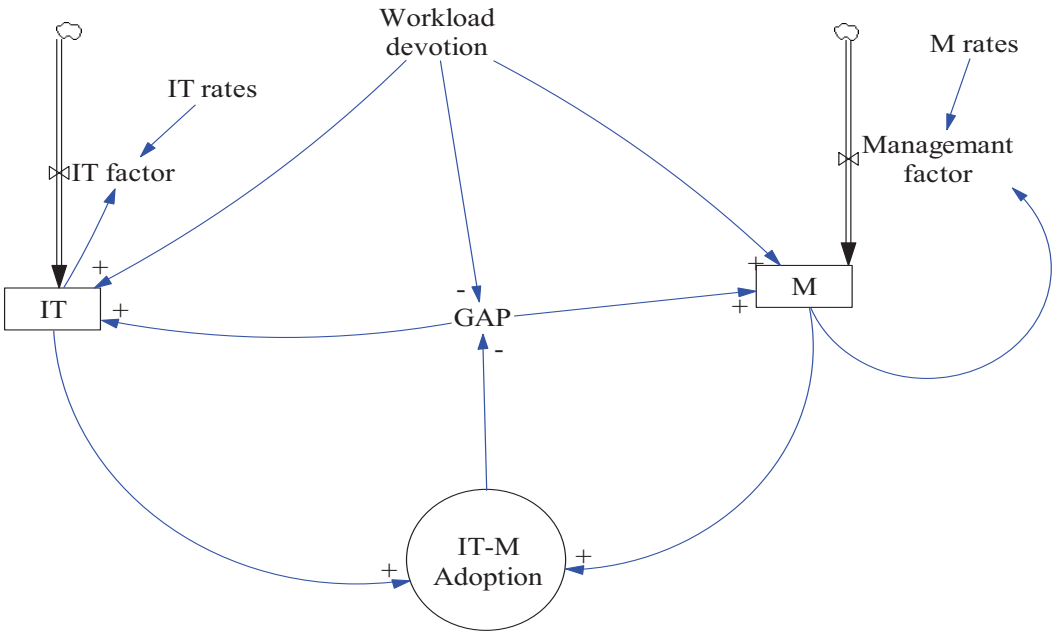
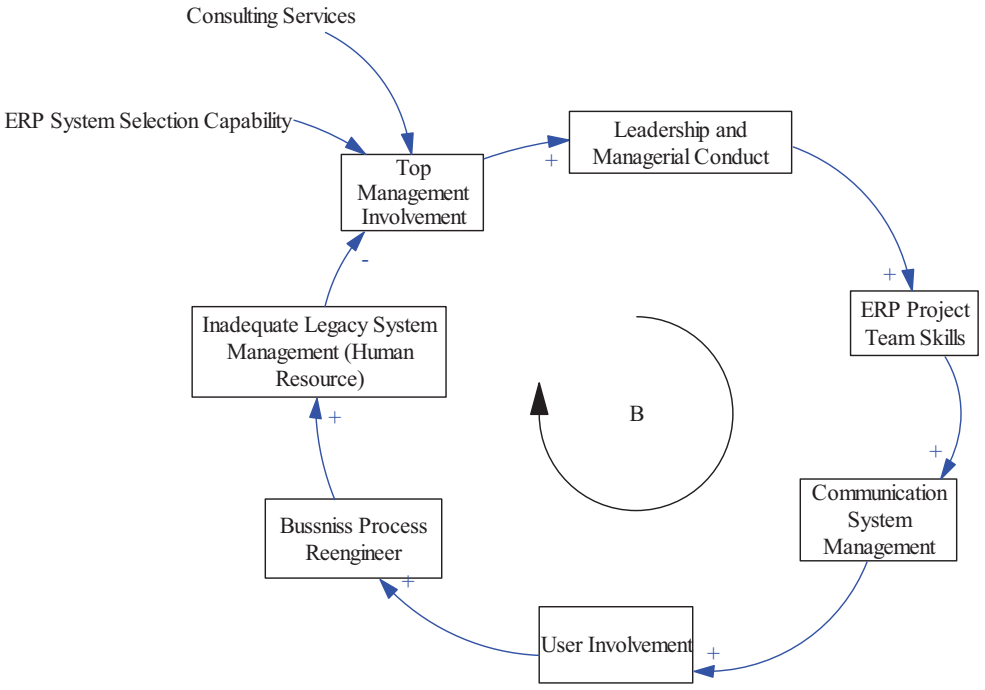
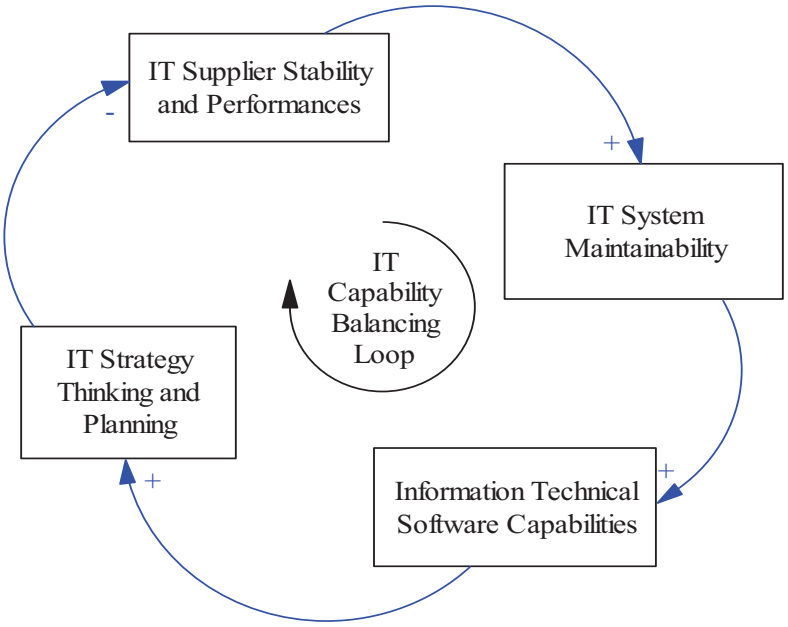


Figure 2



Genera

l Management Capability Casual Diagram



IT Capability Balancing Loop

Model dynamics, purpose and boundary

By our previous qualitative study, we aggregate factors which affect the critical success of ERP introduction into two major stocks i.e. information technology and general management capabilities. We hypothesize that both information technology and general management capabilities could increase the adoption capability thus reduce the gaps while introducing ERP system. The ERP performance Gap serves as a feedback information which signal the manger department to increase workload for both IT and management. We also recognize that these two factors formed two negative loops and we think there will some goal seeking or delay behaviors in this model.

Our main concerns are how to explain the adoption capability affects a firm during the ERP introduction process, how the gap is formed. We also believe that both information technology and general management capabilities play an important role in the ERP adoption process. Many scholars recognized that information technology and general management capabilities take time to mature. We suspect that time delay effect would happen in the adoption process, however, the true mechanism still need to explore.

Some researchers believed that the organizational or personal involvement play a key role for company wise innovation and BPR process. We also suppose the portion of workload that a firm willing to devote to the ERP introduction process may determine the outcomes. We

surveyed some papers knowing that the time frame for the introduction process falls between half to two years. The general staff and managers will be our audience. Top manager's decision for how many portion of resource to assist ERP introduction will be the main exogenous factors.

Model Simulation

RATE = −0.01 OPTIMAL ITM = 0.99 ITM = 0.01

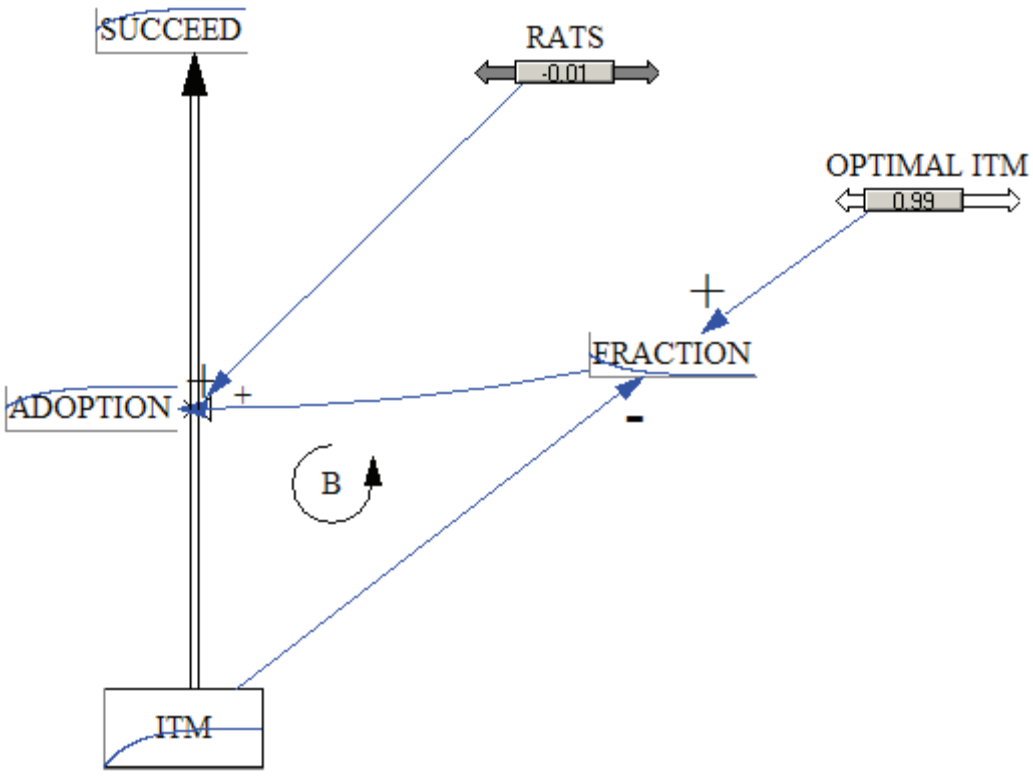
ITM = − ADOPTION

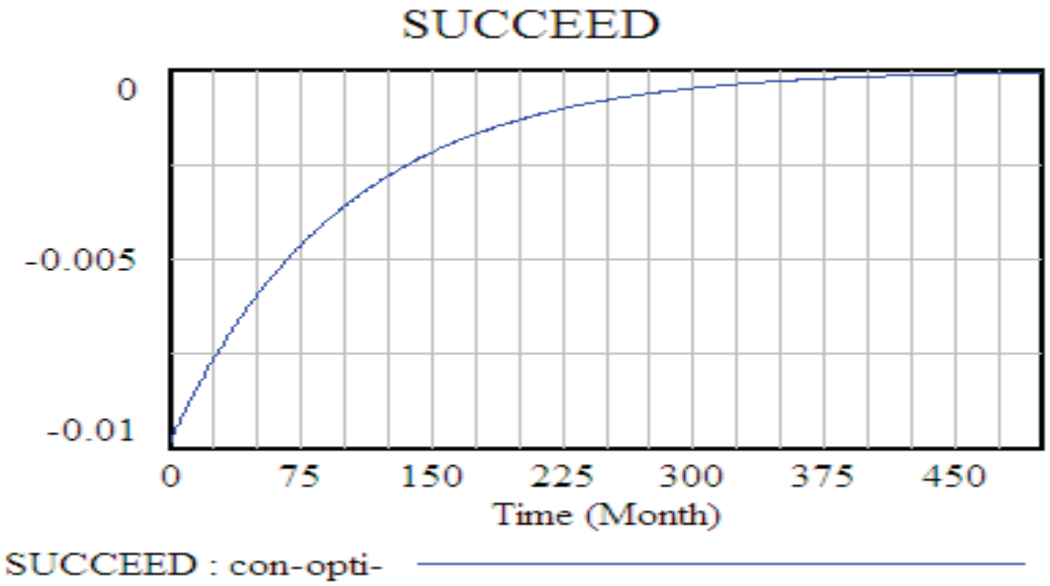
SUCCEED = ADOPTION GAP

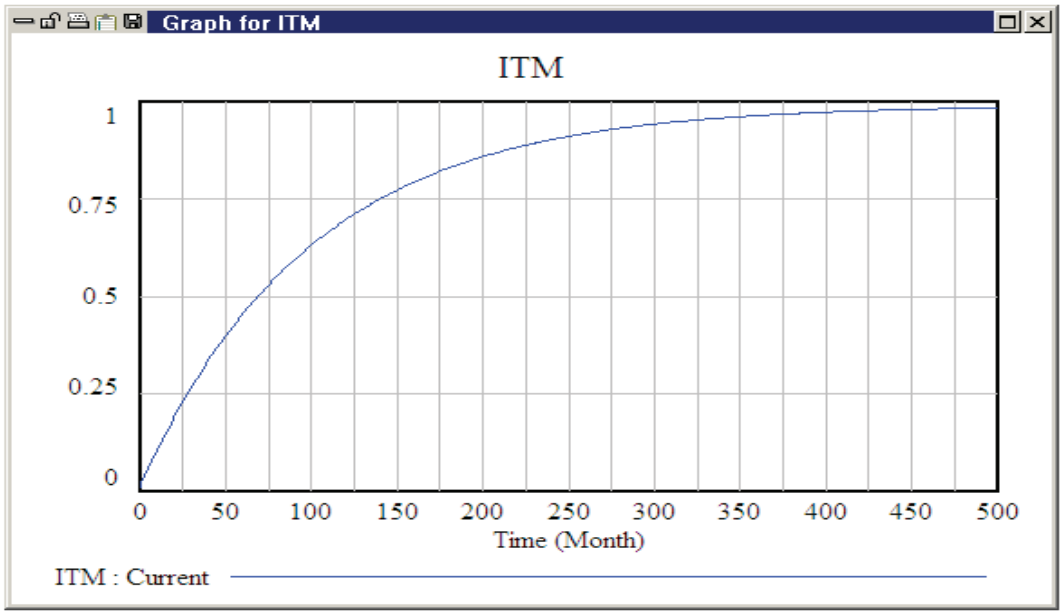
FRACTION = OPTIMAL ITM — ITM

ADOTION GAP = e^{-KT} (ITM−OPTIMAL ITM) + OPTIMAL ITM

$\frac{dADOPTION\ GAP}{dt}$ = RATE * FRACTION = RATE * (OPTIMAL ITM − ITM)







Our simulation model shows that if a firm takes a higher success standard then it takes longer time to reach the desired gap. If a firm want to adopt ERP faster then it could choose either to improve their IT or general management capability to speed up their adoption rate. However, the feedback and information delay structure prolong the capability mature process. This suggests during the ERP adoption process, while narrowing adoption gaps, a firm need more tolerance and support from their top managers to successfully implement ERP project. A firm should find risk factors from those causal relationships and nail down the problem. Step by step, a firm could “kaizen” its adoption process either through BRP or hires more competent IT personnel.

DISCUSSION AND CONCLUSIONS

Feedback and its impacts on decision processes and performance

The purpose of this paper is to show that it is possible to design a ERP adoption gaps model with cognitive feedback. Since feedback is an important information which helps firms to improve themselves continuously. Feedback has been known to be useful in providing decision makers with insights for correction and enhancement of the modeling process. Especially, in the ERP adoption process, cognitive feedback plays an important role. Sengupta et al (1993) suggest that group decision making provides decision makers with a better understanding of their own decision processes and that of the other group members.
From a learning point of view, the single feedback loop shown in the capability mature model of the ERP adoption process reveals the most basic type of learning. The decision makers compare quantitative and qualitative information about the state of the real world to various goals, perceive discrepancies between desired and actual states, and take actions that (they believe will) cause the real world to move toward the desired state. Through this process, the experience is accumulated, the capability is matured and the ERP adoption gaps are pared down.

Contributions

Our ERP adoption gaps analyses provided by system dynamics can be used as a shared mental model for a firm collectively enhance its perceptions of the adoption problems. The benefits of our approaches are (i) a new way to capture qualitative knowledge from both intensive in-depth reviews and meta-knowledge (ii) to derive an operational model for decision support and making policies.

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PRODUCT QUALITY INSPECTION IMPROVEMENT BY ATTRIBUTE ACCEPTANCE SINGLE SAMPLING PLAN AND ITS COMPUTER PROGRAM APPLICATION

Natha Kuptasthien, Rajamangala University of Technology, Thailand
natha.k@en.rmutt.ac.th

ABSTRACT

High competitive market nowadays forces business organizations to compete based on best quality to enhance their competitive advantages in the world market. Inspections of in-coming raw material, manufacturing processes and finished goods become significance to prevent defects which impacts product quality. However, 100% inspection can cause unnecessary time, manpower, machine as well as increase workers' exhaustion and higher inspection cost. This research has an objective to improve an inspection process at an example automotive part factory from 100% inspection to an attribute acceptance single sampling plan. The proposed sampling plan should yield minimum consumer risk with minimum quality inspection cost. A computer application is designed to eliminate repetitive calculations and to support an implementation stage. The research methodology consists of a quality inspection data gathering, a suitable sampling plan selection, a quality cost calculation, a computer software generation, a sampling plan implementation and validation. The result shows a 52.25% quality cost reduction per lot and a 97.65% inspection time reduction per lot. Furthermore, the single sampling plan yields minimum producer's risk with α = 10.54% and minimum consumer's risk with β = 5.41%. The computer program application is validated with user's satisfaction survey. The result shows impressive user satisfaction according to shorter calculation time with 100% precision.

Keyword: Single Sampling Plan, Product Quality Inspection, Quality Improvement

INTRODUCTION

To succeed in a global market nowadays, business organizations are competing with cost, time and quality. Inspections of incoming raw materials, work in process and final products aim to detect defects and prevent them from slipping through manufacturing processes. Several inspection plans have proved their significance and effectiveness. Acceptance sampling is the technique used to verify that products adhere to quality standard. Acceptance sampling inspection can range from 100% to a few items from lot. Even 100% inspection assures zero defects, it causes a high inspection cost, employee's boredom and fatigue from repetitive work. This research is a case study at one of automotive part manufacturers where problems occur according to high inspection cost from 100% inspection. With excellent quality record of zero defects, the quality assurance department looks for possibility in replacing 100% inspection with a sampling plan. The proposed sampling plan must have a customer's approval with minimum consumer's risk and yield minimum producer's risk. This research aims to set up a sampling plan with minimum inspection cost to replace 100% inspection. Moreover, a development of a computer program application by using Visual Basic language helps the inspection team define the most suitable sampling plan parameters (n, c) to reduce repetitive manual calculation and minimize calculation errors.

LITERATURE REVIEWS: ACCEPTANCE SAMPLING PLAN

Fundamentals of Acceptance Sampling

Acceptance sampling can be defined as a statistical process control (SPC) technique used to help make decision to accept or reject lot. Acceptance sampling inspection can occur at the beginning of the process when receiving incoming raw materials, between the process as in the case of work-in-process or at the final inspection. There are different methods to develop sampling plans.

Producer's and Consumer's Risk

Producer's risk is the risk associated with rejecting a lot of materials that has good quality. Producer's risk is denoted by alpha (α) and is referred to as a Type I error. Consumer's risk is the opposite with accepting a bad lot of materials. Consumer's risk is denoted by beta (β) and is called a Type II error. Table 1 shows contrast between alpha and beta risk. Good acceptance sampling plan should reduce producer's risk to low levels, at the same time, maintaining consumer's risk at acceptable levels. (Foster, 2001)

Table 1 Alpha and Beta Risk

	State of Nature	
	Product is Good	Product is Defective
Consumer accepts product	OK	Consumer's risk (β)
Consumer rejects product	Producer's risk (α)	OK

Acceptable Quality Level and Lot Tolerance Percent Defective

The acceptable quality level (AQL) is the maximum percentage or proportion of nonconforming items in a lot that satisfies a process average. It is associated with producer's risk. Lot tolerance percent defective (LTPD) is the level of poor quality that is in a lot. It relates to consumer's risk. Generally, it is a management decision to assign values of AQL, LTPD, producer's risk (α) and consumer's risk (β).

n and c

After an assignment of AQL, LTPD, Producer's risk (α) and Consumer's risk (β), n and c can be determined which set a sampling plan as well. Acceptance sampling plans are designed to give values of n and c, where:

n = the sample size of a particular sampling plan
c = an acceptance number (if defects are higher than c, it causes lot rejection)

OC Curve

The operating characteristic (OC) curve gives an assessment of the probabilities of acceptance for a lot. This curve can be used to develop sampling plans. When c gets smaller, the OC curve gets steeper. This means that higher values of c lead to higher probabilities of accepting bad lot (consumer's risk). Higher values of n result in the OC curves that show

greater confidence in accepting a good lot. There are two ways to construct OC curves. The first uses the binomial distribution and the second, the Poisson distribution. Using a sample size n and average percent defective p, OC curves can be developed by using a Poisson approximation of a binomial distribution. (Grant and Leavenworth, 1999; Montgomery, 2001)

Research Literature Reviews

To use acceptance sampling plans to replace 100% inspection and, at the same time, yield benefits to manufacturer and consumers, it must take consideration with several numbers of OC curves (Dumicic, 2006; Hoying, 2005). They are as follows

1. Increasing of AQL increases the customer's risk, on the other hand an increasing of the producer's risk reduces the consumer's risk.
2. Increasing of LTPD reduces the consumer's risk.
3. When c, AQL and LTPD are fixed; increasing of n can make α higher but β lower.
4. When n, AQL and LTPD are fixed; increasing of c can make α lower but β higher.
5. When n, c and LTPD are fixed; increasing of AQL can make α higher but β stable.
6. When n, c and AQL are fixed; increasing of LTPD can make α stable but β lower.

Figure 1 shows several types of sampling plans. They are attribute sampling plans, variable sampling plans and other sampling plans.

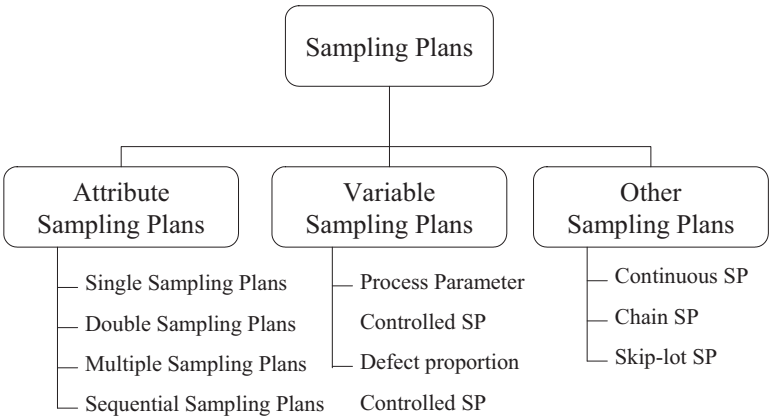

Figure 1 Types of Sampling Plans

Single sampling plan with AQL of 10%, LTPD of 20-29%, α of 5% and β of 10% showed the highest efficiency of 80% (Khan, 2005; Kreetavej, 2005). Several researches showed implementation of single sampling plans to numbers of industrial organizations such as automotive part manufacturing companies and electrical and electronics companies. Development of computer program applications intends to ease repetitive and multi-factors calculations; for example, a sample size (n), an acceptance number (c), a producer's risk (α), a consumer's risk (β), a probability of acceptance (Pa), an average outgoing quality (AOQ) and inspection cost. Moreover, computer program applications were equipped with support

functions such as data documentation, high data processing rate at 4.22-14.11 seconds and 100% accuracy. (Kreetavej, 2005; Ngen Rang and Peungsuk, 1996; Hoying, 2005; Labnonkwa, 2007; Wiengharuethai, 2007). This research aims to implement the attribute single sampling plan generated from the computer program application that provides value of n, c, α, β, Pa and AOQ. The program can produce quality record data. The inspection costs are compared among the single sampling plan, 100% inspection and the rectifying single sampling plan which have not been investigated before.

RESEARCH METHODOLOGY

The research methodology consists of a quality inspection data gathering, a suitable sampling plan selection, a quality cost calculation, a computer software generation, a sampling plan implementation and validation. The details of each step are as follows.

Inspection Data Gathering

At a quality inspection data gathering stage, it shows a high inspection cost of approximately 400,000 baht annually ($12,500) as shown in Table 2.

Table 2 Inspection Cost Year 2007

Month	Output (Units)	Lot size (Units)	Numbers of Lot	Inspection Cost/Lot (Baht)	Total Inspection Cost (Baht)
January	19,200	1,920	10.00	3,121.96	31,219.60
February	24,480	1,920	12.75	3,121.96	39,804.99
March	19,200	1,920	10.00	3,121.96	31,219.60
April	19,680	1,920	10.25	3,121.96	32,000.09
May	24,000	1,920	12.50	3,121.96	39,024.50
June	22,080	1,920	11.50	3,121.96	35,902.54
July	22,080	1,920	11.50	3,121.96	35,902.54
August	20,160	1,920	10.50	3,121.96	32,780.58
September	20,080	1,920	10.46	3,121.96	32,655.70
October	24,960	1,920	13.00	3,121.96	40,585.48
November	22,080	1,920	11.50	3,121.96	35,905.54
December	21,600	1,920	11.25	3,121.96	35,122.05
Total	259,600	-	135.21	-	422,120.21

Moreover, the inspection employees have fatigue and boredom from repetitive inspection procedures. Table 3 shows total time for 100% inspection. Every month, the customer reports defect numbers found after receiving the product. Table 4 shows that out of 259,000 units sent out, there were no defects at all (zero defect). A zero defective rate from Table 4

represents a good quality record. Thus, an acceptance sampling plan is considered to replace 100% inspection with the objective to reduce inspection cost and time.

Select an Acceptance Sampling Plan

The next step is to select an appropriate sampling plan. Review of several single sampling plan and inspection cost literatures found that there are three types of sampling plan (Sukchareonpong, 1992)

1. Attributes Sampling Plan which shows a "Pass" or "Fail" outcome. There are a single sampling plan, a double sampling plan, a multiple sampling plan and a sequential sampling plan.
2. Variables Sampling Plan which shows a measurable parameter when inspection.
3. Other Sampling Plan which is used to decide whether to accept or reject lot. There are a continuous sampling plan, a chain sampling plan and a skip-lot sampling plan.

Cost model of sampling plan (Pipatpanyanukul, 1998) are categorized into 6 types. They are costs of a single sampling plan, a 100% inspection, a rectifying sampling plan, a double sampling plan, a rectifying double sampling plan and an accepting without inspection. Literature review proves that an optimal single sampling plan consists of an Acceptance Quality Level (AQL) of 10%, a consumers' risk (β) of 5%, a producers' risk (α) of 10% and Lot Tolerance Percent Defective (LTPD) of 28 as shown in Table 5.

Table 3 Inspection Time of Year 2007

Month	Output (Units)	Lot size (Units)	Numbers of Lot	Inspection Time/Unit (minutes)	Total Inspection Time (hours)
January	19,200	1,920	10.00	2.14	684.80
February	24,480	1,920	12.75	2.14	873.12
March	19,200	1,920	10.00	2.14	684.80
April	19,680	1,920	10.25	2.14	701.92
May	24,000	1,920	12.50	2.14	856.00
June	22,080	1,920	11.50	2.14	787.52
July	22,080	1,920	11.50	2.14	787.52
August	20,160	1,920	10.50	2.14	719.04
September	20,080	1,920	10.46	2.14	716.19
October	24,960	1,920	13.00	2.14	890.24
November	22,080	1,920	11.50	2.14	787.52
December	21,600	1,920	11.25	2.14	770.40
Total	259,600	-	135.21	2.14	92,590.73

Table 4 Defect Parts from the Customer's Inspection Report of Year 2007

Month	Delivered Product (Units)	Lot size (Units)	Numbers of Lot	Numbers of Inspection (Units)	Defective Rate (%)
January	19,200	1,920	10.00	19,200	0
February	24,480	1,920	12.75	24,480	0
March	19,200	1,920	10.00	19,200	0
April	19,680	1,920	10.25	19,680	0
May	24,000	1,920	12.50	24,000	0
June	22,080	1,920	11.50	22,080	0
July	22,080	1,920	11.50	22,080	0
August	20,160	1,920	10.50	20,160	0
September	20,080	1,920	10.46	20,080	0
October	24,960	1,920	13.00	24,960	0
November	22,080	1,920	11.50	22,080	0
December	21,600	1,920	11.25	21,600	0
Total	259,600	-	135.21	259,600	0

Table 5 The most efficient sampling plan parameters

No.	AQL	LTPD	α	β	Efficiency (%)
1	0.01	0.02-0.11	0.05	0.10	54.97
2	0.02	0.04-0.13	0.05	0.10	57.74
3	0.03	0.06-0.15	0.05	0.10	22.33
4	0.04	0.08-0.17	0.05	0.10	51.69
5	0.05	0.10-0.19	0.05	0.10	49.91
6	0.06	0.12-0.21	0.05	0.10	60.47
7	0.07	0.14-0.23	0.05	0.10	41.27
8	0.08	0.16-0.25	0.05	0.10	70.14
9	0.09	0.18-0.27	0.05	0.10	30.31
10	0.10	0.20-0.29	0.05	0.10	80.00

]With inspection cost comparison between the single sampling plan and the rectifying sampling plan with 100% inspection, the most suitable LTPD is 0.28 or 28% (with lowest inspection cost) as shown in Table 6.

Table 6 Inspection Cost Comparison between the Single Sampling Plan and the Rectifying Sampling Plan with 100% inspection

No.	AQL	LTPD	α	β	Single Sampling Plan Inspection Cost (Baht)	Rectify Sampling Plan Inspection Cost (Baht)	Cost Difference
1	0.10	0.20	0.05	0.10	1,621.15	1,582.26	38.89
2	0.10	0.21	0.05	0.10	1,590.19	1,559.02	31.17

3	0.10	0.22	0.05	0.10	1,569.01	1,548.73	20.28
4	0.10	0.23	0.05	0.10	1,547.00	1,535.90	11.10
5	0.10	0.24	0.05	0.10	1,524.03	1,521.95	2.08
6	0.10	0.25	0.05	0.10	1,515.36	1,518.70	-3.34
7	0.10	0.26	0.05	0.10	1,516.01	1,519.51	-3.50
8	0.10	0.27	0.05	0.10	1,500.86	1,499.11	1.75
9	0.10	0.28	0.05	0.10	1,490.88	1,494.40	-3.52
10	0.10	0.29	0.05	0.10	1,497.62	1,511.72	-14.10

Design Computer Program Flowchart and Database Structure

Visual Basic program is used to create a software application. Program flowchart is shown in figure 2. The program allows a user to set a sampling plan, determine a sample size, calculate number of acceptable part, evaluate accepting lot probability and calculate inspection cost. The software evaluation includes sample size and number of defect calculation, program consistency and quality cost calculation. Computer program uses Poisson probability and product details as calculating and output database. A program installation guideline and a user manual are developed for the implementation step. The installation step is designed to compatible with widely use computer as shown in Figure 3 and 4. Security issue is offered by providing a log-in with username and password protection as shown in Figure 5.

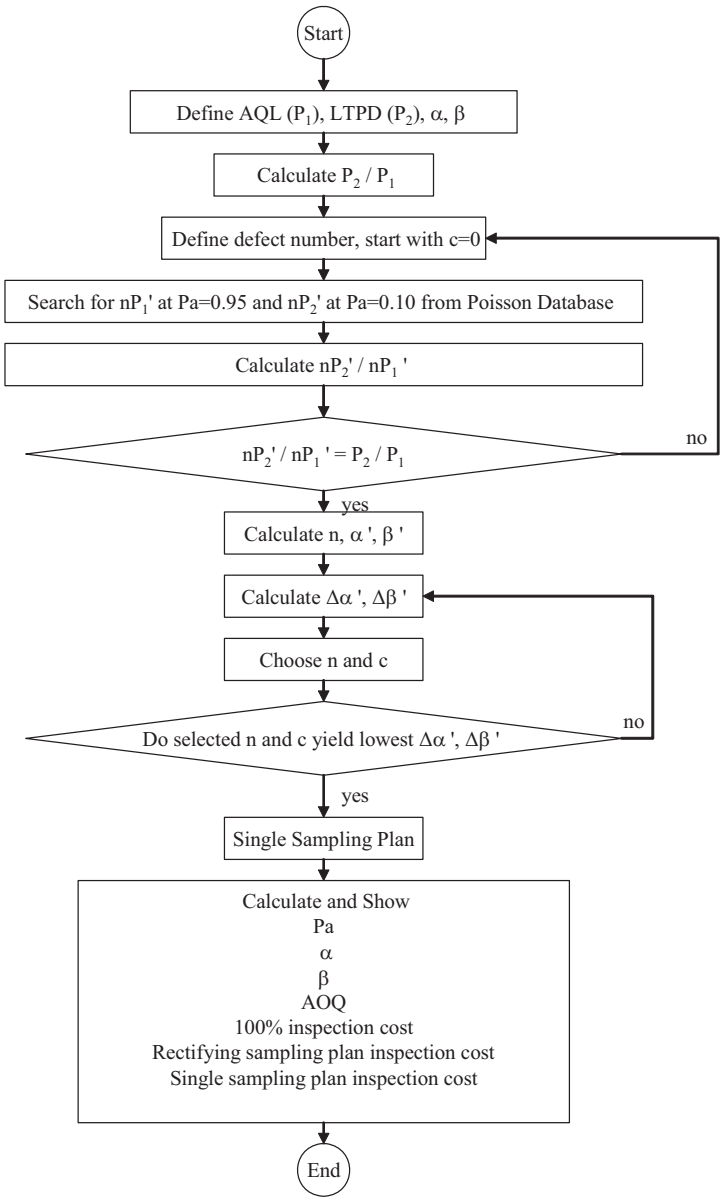

Figure 2 Single Sampling Plan Computer Program Flow Chart

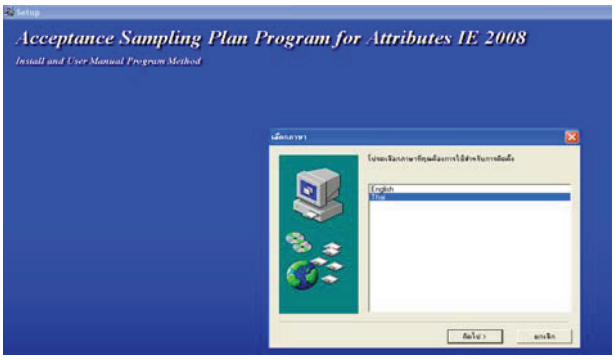

Figure 3 Installation Page

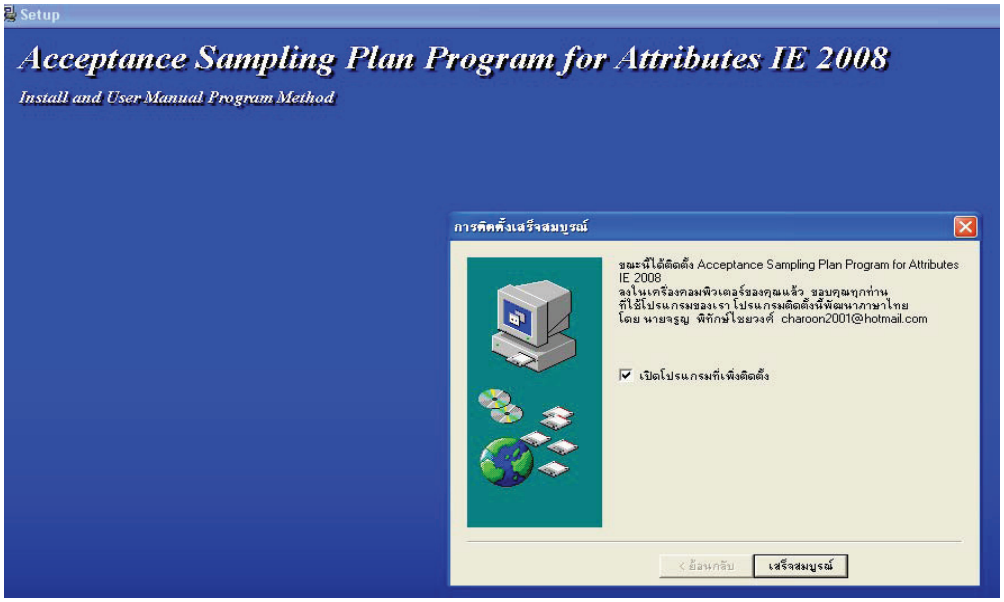

Figure 4 Installation Page

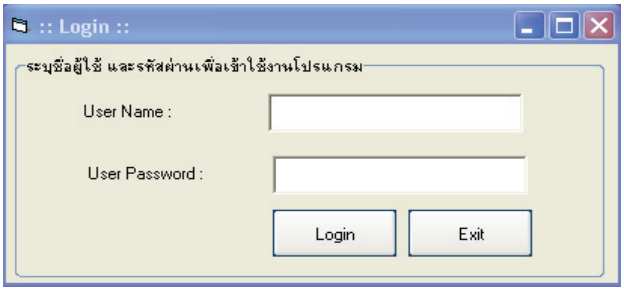

Figure 5 Login with Password Protection

RESULT

The implementation stage lasted 3 months. The factory changed from 100% inspection to the attributed single sampling plans generated from a computer program application as shown in Figure 6. There were 58 lots went through the final inspection with the designed sampling plan as follows.

N (lot size)	=	1,920	units
n (sample size)	=	46	units
c (defective numbers)	=	8	units
AQL	=	10	%
LTPD	=	28	%
Producer's Risk	=	5	%
Customer's Risk	=	10	%
AOQ	=	9.41	%
Pa	=	96.36	% (at 8 defects) and 99.21% (at 0 defect)

Inspection costs are compared among 3 types of inspection plan. Figure 7 shows that the single sampling plan resulted in the lowest inspection cost of 1,490.88 Baht/lot.

After the implementation stage with computer software application, the result shows a 52.25% quality cost reduction per lot and a 97.65% inspection time reduction per lot. Furthermore, the single sampling plan yields minimum producer's risk with α = 10.54% and minimum consumer's risk with β = 5.41%. The computer program application is validated with user's satisfaction survey. The result shows impressive user satisfaction according to shorter calculation time with 100% precision.

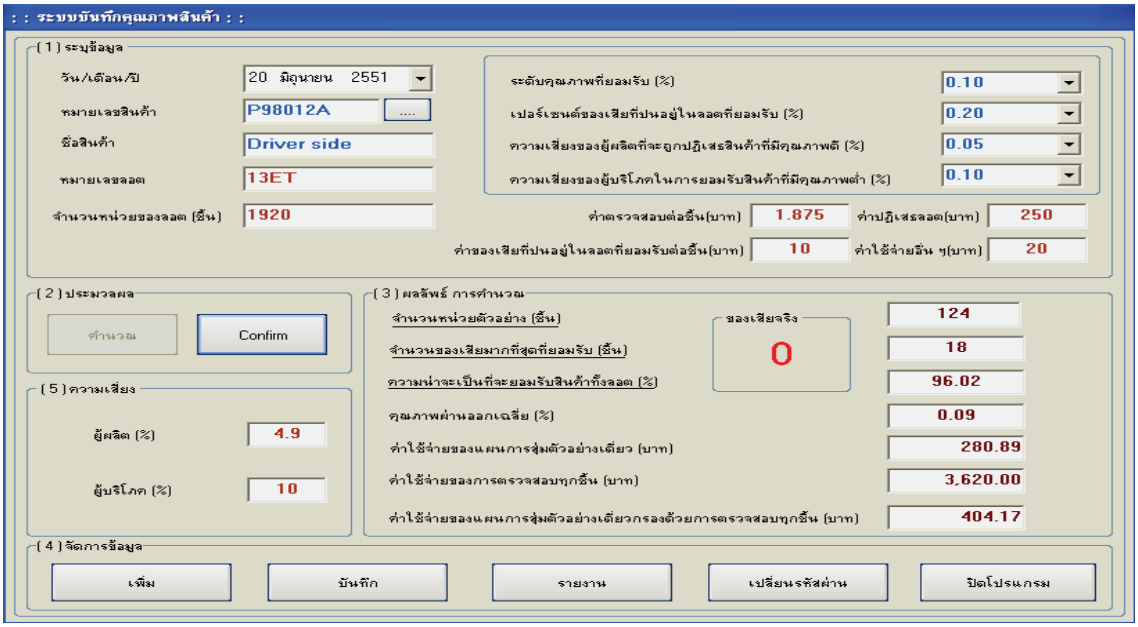

Figure 6 Example of Data Input

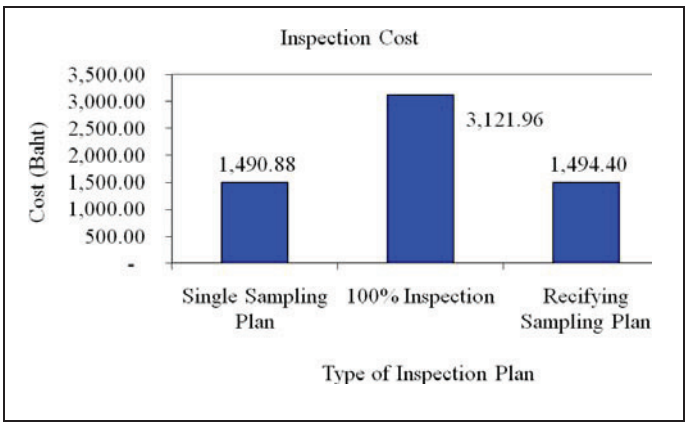

Figure 7 Inspection Costs Comparison

DISCUSSION

Hoying (1999), Kreetavej (2004), Ngen Rang Peungsuk (1996)'s studies are similar in term of a construction of a single sampling plan with n and c calculations. This research enhances from other similar research studies with the considerations of different inspection costs. The selected sampling plan not only minimizes producer's risk and consumer's risk but also

minimizes the inspection cost. Visual Basic program has been widely used as a tool for creating a computer application including this research and other studies in this field. The differences are the user interface format and graphic design due to dissimilar research applications. This research studies only the single sampling plan with the producer's risk of 5% and consumer's risk at 10%, AQL 10%, LTPD 28% and lot size of 1,920 units. An investigate of relationships between changing values of producer's risk and consumer's risk and lot size is a possible further study.

CONCLUSION

In conclusion, the attribute single sampling plan and its computer program application can efficiently replace 100% inspection with some advantages. It results in decreasing quality inspection cost 52.25%, reducing inspection time 97.65%, minimizing producer's risk at 4.51% and consumer's risk at 10.54%, less inspection employee and decreasing inspection errors. On the other hand, the disadvantages remain risks of accepting a bad lot and rejecting a good lot, some calculation difficulties. The employee's education is required according to building up knowledge of acceptance sampling plan technique. An enhancement of the computer program application with an automatic command which connects to sensor or inspecting robots can be a future research.

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A COMPARATIVE ANALYSIS OF THE BEHAVIORAL MODEL OF WIKIPEIA BY SOCIAL ROLES

Ms. Nai-Ching Yeh, National Taiwan University of Science and Technology, Taiwan
cherish.yeh@msa.hinet.net
Dr. Judy Chuan-Chuan Lin, Soochow University, Taiwan
jclin@csim.scu.edu.tw
Dr. Hsi-Peng Lu, National Taiwan University of Science and Technology, Taiwan
hsipeng@cs.ntust.edu.tw

ABSTRACT

Wikipedia is an impressive service based on the user-created content trends of Web 2.0. Prior studies have separately explored such related dimensions as information quality issues, technical characteristics, and motivational views. However, they have paid little attention to how behavioral models differ according to users' social roles. Based on the social presence theory, the extended Technology Acceptance Model, and the IS success model, and the interactive characteristic of Wikipedia, we propose behavioral models for two types (or social roles) of users. A survey of 331 users of Chinese Wikipedia revealed that 104 subjects (31.4%) were enthusiastic participants and edited information, while 227 subjects (68.6%) mainly browsed or occasionally responded to the information. One-way ANOVA showed significant differences between these two groups. This study empirically confirmed the existence of different behavioral models for the distinct user types (Wikimembers and non-Wikimembers). Among Wikimembers, perceived ease of use and perceived enjoyment had significant direct effects on intention to use, while for non-Wikimembers, perceived ease of use, perceived usefulness, social presence, and perceived enjoyment had significant direct effects on intention to use.

Keywords: social role, social presence, interactivity quality, TAM, IS success model

INTRODUCTION

Wikipedia, one of the most impressive example of an online encyclopedia, has promoted the rapid growth of user created content (UCC) since 2001. Wikipedia is collaborative and user-generated source of content on various subjects. Several web traffic-measuring firms indicate that Wikipedia is one of the most frequently visited sites on the internet (Rainie & Tancer, 2007). The content created by users has grown enormously to more than 968 million articles in over 255 languages, and daily requests in October 2008 amounted to 13.3 million

pages (Wikipedia, 2008).

The high user acceptance of Wikipedia raised intense discussion about related issues in academic research. Lih (2004) focused on information quality and established a set of metrics to evaluate the quality of Wikipedia's content. Extending the concept of the importance of social roles in human interaction, we propose that it is essential not only for information contributors but also for receivers to consider UCC schema. Bettencourt and Sheldon (2001) defined a social role as a behavioral repertoire characteristic of a person or position, and they emphasized that certain behaviors are characteristic of specific people.

Focusing on the different influences on human behavior of distinct social roles, Golder and Donath (2004) analyzed social interactions and their impact on newsgroup communities to construct the taxonomy of roles. In the Web 2.0 context, Hsu and Lin (2008) mentioned that not only must bloggers (weblog writers) update content regularly, but also blog readers must visit and frequently interact with an active weblog. Moreover, IP and Wagner (2008) deduced four types of weblog user by associating needs and technological features, and they labeled the roles ad habitual, active, personal, and blogging lurkers.

However, there is a lack of empirical studies to verify that behavioral models differ from social roles. Therefore, based on interactive characteristics, our study investigates the Wikipedia user behavioral model for two types of users (writer and reader), with the following two objectives: (1) Explore the factors influencing intentions to use Wikipedia from technological, social, and quality perspectives, and build a user behavioral model. (2) Examine whether there exist different behavioral models for distinct types of Wikipedia user.

LITERATURE REVIEW

Web 2.0 and User-created Content (UCC)

The innovative characteristics of Web 2.0 attracted the attention of academics and businesses (O'Reilly, 2005). In contrast to Web 1.0, Web 2.0 websites not only permit users to access online information, but also to execute software through a browser, and users can own and control the data (O'Reilly, 2005). Web 2.0 as a participation platform encourages people to interact, such as through talking and shopping, so social commerce was enhanced. UCC was the controversial issue raised by the rapid growth of Web 2.0, and it was a result of the effort syndication described by Clarke (2008). The concept of UCC refers to internet use characterized by increased participation and interaction among internet users who communicate and express themselves through this medium.

According to the results of the Pew Internet and American Life Project survey (Rainie & Tancer, 2007), prior to 2005, more than one-third (35%) of all US internet users had posted content on the internet. At the end of March 2006, there were 6.2 million bloggers and 25.4 million blog readers in Japan. At the same time, there were approximately 5.1 million members of social network sites. These findings show UCC trends extending worldwide.
In our study, we propose a user behavioral model for Wikipedia the one popular type of UCC practice. Bases on the Technology Acceptance Model (TAM) and DeLone and McLean's IS success model, we especially focus on the social perspective factor "social presence" and the characteristics of Web 2.0 "interactivity quality". Responding to the suggestion that human behaviors are different from social roles (Golder & Donath, 2004; Hsu & Lin, 2008; IP & Wagner, 2008), we then compare the behavioral model with two user types (Wikimembers and non-Wikimembers).

Social Presence

Social presence was regarded as a quality inherent in communication media and was defined as the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal relationship (Walther, 1992). Tu and Isaac (2002) considered that social presence was the degree of feeling and perception of, and reaction to, connection to another intellectual entity in computer-mediated communication. Moreover, Tu (2000) combined the social learning and social presence theories and indicated that social presence is required to enhance and foster online social interaction.

Some prior studies concentrated on social presence in the interactivity of media and the relationship with information richness (Straub & Karahanna, 1998). Other research focused on media providing social presence as a users' sense of human warmth and sociability (Kumar & Benbasat, 2006). In addition, Gefen and Straub (2003) verified that online consumers' perceptions of social presence in online applications positively influenced their intention to purchase from a website, and enhance users' online shopping experiences and reduce their cognitive burden from a specific website (Kumar & Benbasat, 2002). Because Web 2.0 deeply involves social interaction and emphasizes creation and enrichment of users' online experiences, this paper argues from the social perspective that social presence is an important belief factor affecting intention to use Web 2.0 applications.

Interactivity Quality

Generally, interactivity is a process-related variable characteristic of communication settings.

In a review of the literatures, interactivity includes three dimensions: control, exchange of roles, and mutual discourse (Williams et al., 1988). Concerning with the new media, interactivity comprises six dimensions, such as complexity of choice available, the effort that users must exert, site responsiveness to users, site monitoring of users' information use, users' ease of adding information, and facilitation of interpersonal communication (Heeter, 1989). Specific to the web environment, playfulness, choice, connectedness, information collection, and reciprocal communication were proposed as the important dimensions in studying business web sites (Ha & James, 1998).

In early stages, interactivity was applied to fields such as computer-mediated communication (Burgoon et al., 2000) and human–computer interaction (Campos & Nunes, 2007). Gradually, the focus of interactivity research was diverted to electronic commerce, such as advertising (Sicilia et al., 2005), web browsing (Samberg & Kimmel, 2004), online retailing (Ballantine, 2005), and online games (Choi & Kim, 2004). Moreover, Hoffman and Novak (1996) proposed two main types of interactivity considered applicable to the web: personal interactivity and machine interactivity.

Based on the prior research mentioned above, this study integrates the definitions from various contexts and applications and defines interactivity quality from two perspectives. For the technical dimension, we emphasized the platform function, which can provide user control, user choice, and user response ability (Ballantine, 2005). For the social dimension, we considered the sociability function, which can create a sense of place and provides social communication (McMillan & Downes, 2000; Ballantine, 2005).

Technology Acceptance Model

Davis (1989) developed the technology acceptance model (TAM), which was widely adopted to investigate users' beliefs and acceptance of new information systems. In the TAM, both perceived usefulness and perceived ease of use are beliefs likely to be affected by external variables. Moreover, the TAM suggests that perceived usefulness has direct effects on positive attitude and behavioral intention. Perceived ease of use has direct effects on perceived usefulness and attitude, and attitude and behavioral intention have a positive relationship. Many previous studies applied and even extended the TAM within WWW online contexts (Lin & Lu, 2000; Hsu & Lu, 2007; Hassanein & Head, 2007). Recently, the TAM has been popularly adopted in the Web 2.0 environment, such as in virtual communities (Shin, 2008) and weblogs (Hsu & Lin, 2008).

Perceived Enjoyment

Perceived enjoyment has been defined as the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated (Koufaris, 2002). While perceived usefulness and perceived ease of use are extrinsic motivational factors, perceived enjoyment has been found to have significant impact on users' acceptance of technology from the intrinsic motivational perspective in such contexts as internet and websites use (Teo et al., 1999), user acceptance enablers (Venkatech et al., 2002), online services (Hwang & Kim, 2007), learning systems (Teo, 2008), interface agents (Serenko, 2008), and online shopping (Hassanein & Head, 2007; Ha & Stoel, 2008).

Moreover, in the hedonic-oriented online interactive environment, perceived enjoyment is also popularly considered as an important factor affecting the adoption of a technology, such as online games (Weibel et al., 2008) and instant messaging (Lu et al., 2009). Furthermore, Hsu and Lin (2008) suggested and verified that perceived enjoyment had a significant direct effect on attitudes toward Web 2.0 applications, such as blogs. Therefore, we proposed perceived usefulness, perceived ease of use, and perceived enjoyment as the basic factors affecting intention to use Web 2.0 applications.

IS Success Model

Many studies have investigated the relationships between IS qualities and users' acceptance of technology, and they adopted the quality variables as antecedents of the belief constructs of the TAM. DeLone and McLean (1992) used the IS success model as a framework for measuring the complex dependent variables in IS research. The D&M IS success model suggested six independent dimensions for IS success: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. With the internet developing swiftly, IS researchers have focused on exploring e-commerce success measures and have proposed e-commerce-related success models based on the D&M IS success model (Liu & Arnett, 2000). DeLone and McLean (2003) evaluated related studies and proposed an updated D&M IS success model to measure WWW applications.

The updated D&M IS success model (2003) indicates that system quality in the internet environment is measured by the characteristics of an e-commerce system; information quality, by the e-commerce content issues and service quality, by overall support delivered by a service provider. Some researchers suggest that quality factors are important in user beliefs (Lin & Lu, 2000; Ahn et al., 2007). Nevertheless, few studies on the basic characteristics of

Web 2.0 application have considered interactivity quality combined with the quality factors of the IS success model. The Web 2.0 context concerns interactive characteristics rather than online services, and therefore we propose interactivity quality (as a substitute for service quality) to be the antecedent factor of user perceptions.

RESEARCH MODEL AND HYPOTHESES

TAM and Perceived Enjoyment

According to the original version of the TAM, Davis et al. (1992) showed that perceived usefulness and perceived enjoyment affected intention directly, and that perceived ease of use influences intention indirectly via perceived usefulness. Previous studies have found support for the above-mentioned relationships in various applications. For example: Heijden (2003) used a sample of 828 respondents to test the model in portal website usage, and Lu et al. (2009) surveyed 250 subjects to confirm hypotheses on instant messaging. Additionally, Serenko (2008) confirmed a direct relationship between perceived ease of use and intention to use. Accordingly, we proposed the following hypotheses.

【H1a】Perceived ease of use is positively related to perceived usefulness in Wikipedia
【H1b】Perceived ease of use is positively related to intention to use Wikipedia
【H1c】Perceived usefulness is positively related to intention to use Wikipedia
【H1d】Perceived enjoyment is positively related to intention to use Wikipedia

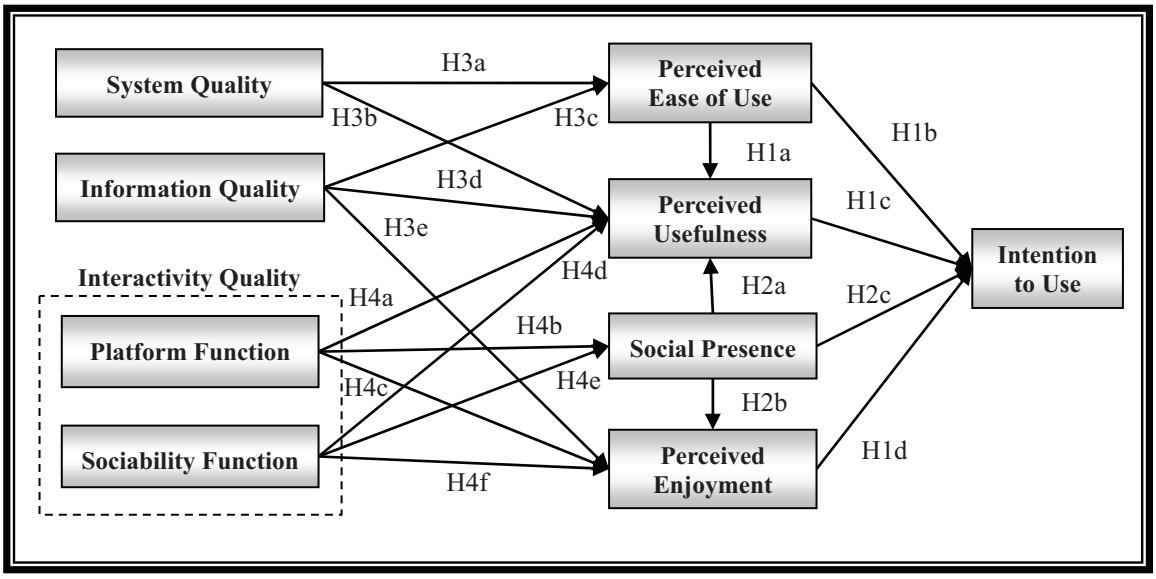


Fig. 1 Proposed research model

Social Presence

In the online shopping context, Hassanein and Head (2007) proposed that when a website

serves as a communication interface, perceived social presence may be expected to be positively related to perceived usefulness, and the relationship was discussed and verified in previous studies (Karahanna & Straub, 1999). In virtual entertainment systems, when users have a strong sense of having entered another world, they enjoyed the experience more (Heeter, 1995). In online shopping websites, increasing levels of perceived social presence result in greater enjoyment of specific websites (Hassanein & Head; 2007), and Gefen and Straub (2003) found that social presence affects consumers' trust, with increased trust exerting a stronger effect on purchase intentions than TAM beliefs. Furthermore, an extended TAM was established for online shopping and proposed that users' perceptions of social presence positively affect their intentions to patronize an e-commerce website (Lingyun & Dong, 2008). This leads to the following hypotheses.

【H2a】Social presence is positively related to perceived usefulness in Wikipedia
【H2b】Social presence is positively related to perceived enjoyment in Wikipedia
【H2c】Social presence is positively related to intention to use Wikipedia

IS Success Model

Over the past decade, the TAM has been widely applied to predict the adoption and usage of information systems. Davis (1989) addressed attitudes as antecedents of beliefs. By exploring the behavioral intention to use a website, Lin & Lu (2000) proposed information quality, response time, and system accessibility as IS qualities that influence user beliefs (perceived ease of use, perceived usefulness). Providing an excellent review of TAM studies, Venkatesh et al. (2002) considered that system and information characteristics might influence the core beliefs in the TAM. Moreover, Hwang and Kim (2007) proposed perceived web quality as an antecedent of affective reaction, such as enjoyment and anxiety. Accordingly, we posited the following hypotheses.

【H3a】System quality is positively related to perceived ease of use in Wikipedia
【H3b】System quality is positively related to perceived usefulness in Wikipedia
【H3c】Information quality is positively related to perceived ease of use in Wikipedia
【H3d】Information quality is positively related to perceived usefulness in Wikipedia
【H3e】Information quality is positively related to perceived enjoyment in Wikipedia

Interactivity Quality

Researching instant messaging, Huang et al. (2008) built a research model to explore the potential effects of emotions and advocated the view that personal interaction is positively related to enjoyment and perceived usefulness. Interactivity was likely to create feelings of social presence for a user through the availability of open channels allowing for two-way

communication (Dholakia et al., 2001). Furthermore, Fortin and Dholakia (2005) verified a positive relationship between the social presence and interactivity of a website and an advertisement. Base on previous studies, interactivity quality was induced to technological and social perspective (McMillan & Downes, 2000; Ballantine, 2005), therefore, we distinguish interactive quality into two dimensions—platform function and sociability function, and we assume the following hypotheses.

【H4a】 Interactivity quality(Platform function) is positively related to perceived usefulness in Wikipedia

【H4b】Interactivity quality(Platform function) is positively related to social presence in Wikipedia

【H4c】Interactivity quality(Platform function) is positively related to perceived enjoyment in Wikipedia

【H4d】Interactivity quality(Sociability function) is positively related to perceived usefulness in Wikipedia

【H4e】Interactivity quality(Sociability function) is positively related to social presence in Wikipedia

【H4f】Interactivity quality(Sociability function) is positively related to perceived enjoyment in Wikipedia

METHODOLOGY

Measurement Development

This study used a web-based questionnaire survey to examine the research model and test the proposed hypotheses. The items were based on the TAM, the IS success model, and social psychology literature and were slightly modified to correspond to the context of the Web 2.0 interactive environment. The questionnaire consisted of two parts: the first had 41 items to measure the constructs in the research model, and the second had questions about the participants' demographic attributes. Each item of the constructs was based on related studies and had a five-point Likert response scale, ranging from "strongly disagree" (1) to "strongly agree" (5). The measures of perceived ease of use, perceived usefulness, and intention to use were adopted from previous studies related to the TAM (Hassanein & Head, 2007; Ahn et al., 2007). System quality and information quality were measured with items from the IS success model (Lin & Lee, 2006). The five items measuring interactive quality of platform function were adopted from McMillan and Downes (2000) and Ballantine (2005), and interactive quality of sociability function used a six-item scale developed by McMillan and Downes (2000) and Ballantine (2005). Social presence was measured by four items adopted from Kumar and Benbasat (2006). To address the items of perceived enjoyment, this study used a

four-item scale developed by Hassanein and Head (2007).

cPre- test and Pilot- test

After the questionnaire was developed, we performed a pilot test with seven graduate students and professors in the e-commerce and information management fields and revised the wording and syntax for greater accuracy. Then we invited 45 Chinese Wikipedia users to participate in the pilot test for three days. We examined the reliability using the Cronbach's α value of each construct. The results show that the values ranged between 0.80 and 0.95 and exceeded the threshold value of 0.7 (Nunnally, 1978). We also tested the validity of the measurement with a factor structure matrix of loadings and cross-loadings, and the results reveal that the items had higher factor-loadings with related factor items and low cross-loadings with other factors, indicating that the measurement holds good convergent and discriminant validity.

Subjects

We conducted an online questionnaire and invited Chinese Wikipedia users to participate in our survey to test the research model and hypotheses. Over a one-month period, we received 345 responses and eliminated redundant entries by checking duplicate IP addresses and repeated email addresses. A total of 331 valid subjects for the online survey were included: 215 males (65%) and 116 females (35%). Majority of subjects held at least bachelor degrees (86.4%). With respect to member attributes, about 104 subjects (31.4%) were enthusiastic Chinese Wikipedia members who edited information and 227 (68.6%) mainly browsed or occasionally responded to the information on Chinese Wikipedia.

Table 1 Comparison of Wikimember and Non-Wikimember using One-way ANOVA

Construct	Mean value of Wikmember	Mean value of Non-Wikmember	F test	P value
System quality (SQ)	4.00	3.85	5.66 *	0.018
Information quality (IQ)	3.68	3.68	0.002	0.963
Interactivity quality of platform function (IQP)	3.89	3.59	19.73 ***	0.000
Interactivity quality of sociability (IQS)	3.85	3.41	28.07 ***	0.000
Perceived ease of use (PE)	4.14	3.97	6.08 *	0.014
Perceived usefulness (PU)	4.06	3.85	7.67 ***	0.006
Social Presence (SP)	3.63	3.12	29.31 ***	0.000
Perceived enjoyment (PEN)	4.08	3.50	40.05 ***	0.000
Intention to use (INT)	4.52	4.08	30.76 ***	0.000

*** p< 0.001; ** p<0.01; * p<0.05

We compared the variances of characteristics between two subject groups—Wikimembers and Non-Wikimembers for all constructs using a one-way ANOVA analysis. The results showed that the two subject groups' member attributes had significant differences in terms of system quality [F = 5.67, P < 0.05], interactivity quality (platform function) [F = 19.73, P < 0.001], interactive quality (sociability function) [F = 28.07, P < 0.001], perceived ease of use [F = 6.08, P < 0.05], perceived usefulness [F = 7.67, P < 0.01], social presence [F = 29.31, P < 0.001], perceived enjoyment [F = 40.05, P < 0.001], and intention to use [F = 30.76, P < 0.001]. The mean values of all constructs for two groups are shown in Table 1.

DATA ANALYSIS

Descriptive Statistics

The averages of all constructs were greater than 3.28 out of 5, and the results indicate that our subjects positively participated in the Web 2.0 interactivity environment of Chinese Wikipedia. Considering the distributional characteristics of the data, D'Agostino (1986) conducted a skewness and kurtosis test method. The results showed in Table 2 indicated that skewness and kurtosis were significant for overall assessment, meaning the data had deviated significantly from normality. However, for structural equation modeling (SEM) techniques, multivariate normality is needed (Johnson & Wichern, 1998; Walczuch et al., 2007). The skewness of data may limit the validity of maximum likelihood estimation techniques. To avoid the limitation, therefore, we adopted partial least square (PLS), which not only accepts wider range of residual distributions and sample size (Chin, 1998), but was applied widely in recent research (Hong & Tam, 2006; Cyr et al., 2006).

Table 2 Overall skewness and kurtosis

Skewness			Kurtosis			Skewness and Kurtosis	
Value	Z-Score	P-Value	Value	Z-Score	P-Value	Chi-Square	P-Value
421.177	55.337	0.000	2163.854	24.065	0.000	3641.316	0.000

The Measurement Model

Cronbach's α values of all constructs exceeded the threshold of 0.7 (Nunnally, 1978), ranging from 0.7 to 0.94 and thus capturing a high degree of variance in each construct. Notably, the composite reliabilities of all constructs exceeded the threshold of 0.7 (Nunnally, 1978), ranging from 0.86 to 0.96 with high internal consistency of scales. Therefore, all constructs in the model had satisfactory construct reliability. Content validity concerned the representation of the items of a specific construct (Cronbach, 1971), and all constructs in our study were

derived from prior studies and related literature.

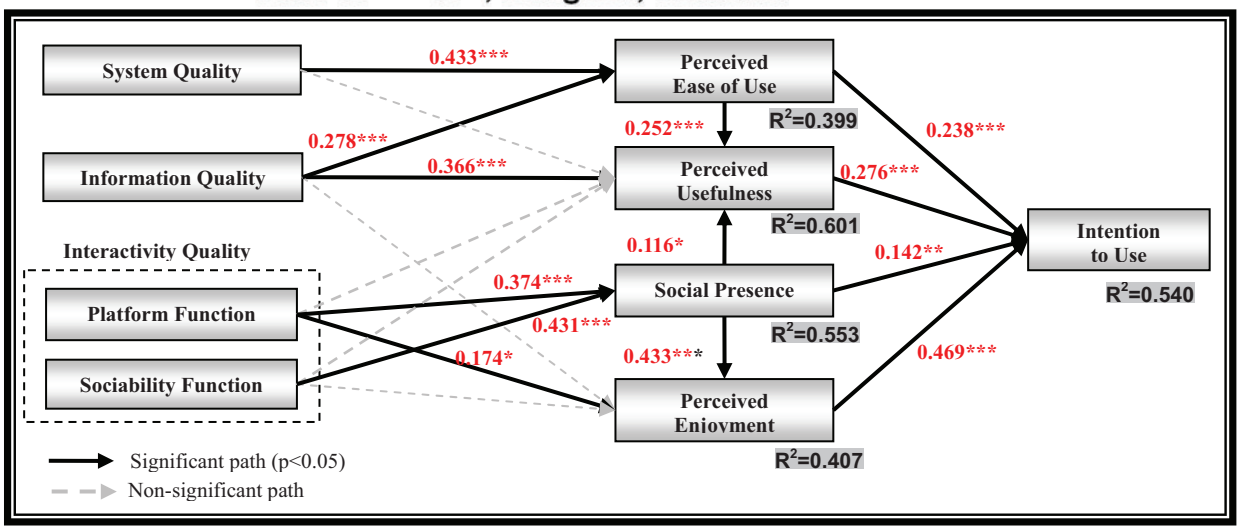
In addition, the average variance extracted (AVE) for all constructs exceeded the threshold value of 0.5, demonstrating that the scales had good convergent validity (Fornell & Larcker, 1981; Hairs et al., 1998). To evaluate discriminant validity, this study compared the square root of AVE and correlation coefficients with other constructs. As shown in Table 3, the correlations between any two constructs were lower than the square root of the AVEs within the construct, satisfying Fornell and Larker's (1981) criterion for good discriminant validity. We also examined discriminant validity by using PLS cross factor loadings analysis, the loadings of measurement items corresponding to their constructs, which should be larger than the items factor loadings on other constructs, and which satisfied the criteria that the loadings of all measurement items on any construct should be below 0.6 (Gefen & Straub, 2005).

Table 3 Discriminant validity (N=331)

	Average variance (AVE)	INT	IQ	IQP	IQS	PE	PEN	PU	SP	SQ
INT	0.86	0.927								
IQ	0.56	0.441	0.745							
IQP	0.57	0.452	0.606	0.758						
IQS	0.72	0.340	0.451	0.711	0.847					
PE	0.67	0.551	0.524	0.516	0.320	0.816				
PEN	0.85	0.635	0.410	0.541	0.484	0.435	0.924			
PU	0.77	0.595	0.684	0.624	0.503	0.599	0.532	0.876		
SP	0.76	0.377	0.455	0.680	0.696	0.361	0.608	0.525	0.873	
SQ	0.51	0.463	0.578	0.654	0.476	0.591	0.473	0.589	0.483	0.711

The diagonal values represent the square root of AVEs

The structural model



*** p< 0.001; ** p<0.01; * p<0.05

Fig.2 Testing results of the purposed research model — all subjects (N=331)

A test of the structural model was performed using the PLS procedure, and the results for all subjects (n = 331) are indicated in Fig. 2. The structural model showed that system quality (β = 0.43, p < 0.001, H3a supported) and information quality (β = 0.28, p < 0.001, H3c supported) significantly affected perceived ease of use (R^2 = 0.399). Additionally, perceived ease of use (β = 0.25, p < 0.001, H1a supported), information quality (β = 0.37, p < 0.001, H3d supported), and social presence (β = 0.12, p < 0.05, H2a supported) had a significant direct effect on perceived usefulness (R^2 = 0.601). Likewise, platform function of interactivity quality (β = 0.37, p < 0.001, H4b supported) and sociability function of interactive quality (β = 0.43, p < 0.001, H4e supported) significantly affected social presence (R^2 = 0.553). Whereas social presence (β = 0.43, p < 0.001, H2b supported) and platform function of interactivity quality (β = 0.17, p < 0.05, H4c supported) had strong effects on perceived enjoyment (R^2 = 0.407), the effects of information quality and the sociability function of interactivity quality were, however, weak in this study. As expected, perceived ease of use (β = 0.24, p < 0.001, H1b supported), perceived usefulness (β = 0.28, p < 0.001, H1c supported), social presence (β = 0.14, p < 0.01, H2c supported), and perceived enjoyment (β = 0.47, p < 0.001, H1d supported) significantly affected intention to use (R^2 = 0.540). Because the results of one-way ANOVA analysis show that the two subject groups' member attributes, namely Wikimembers and Non-Wikimembers, had significant differences in the proposed research model. We tool a step further and analyzed the PLS path analysis of subgroup of Wikimembers (n = 104) and non-Wikimembers (n = 227) respectively.

CONCLUSION

Discussion

As the results show in Table 4, information quality ($\beta = 0.19$, $p < 0.01$, H3e supported) and platform function of interactivity quality ($\beta = 0.20$, $p < 0.05$, H4c supported) had significant direct effects on perceived enjoyment, also, perceived ease of use ($\beta = 0.27$, $p < 0.001$, H1a supported) significantly affected perceived usefulness for non-Wikimembers but not for Wikimembers. Furthermore, perceived usefulness ($\beta = 0.43$, $p < 0.001$, H1c supported) and social presence ($\beta = 0.21$, $p < 0.001$, H2c supported) had strong effects on intention to use only in the non-Wikimembers group.

Table 4 Path analysis of two groups (Wikimembers and non-Wikimembers)

	Wikimembers (N=104)		non-Wikimembers (N=227)	
	R^2	β	R^2	β
SQ -> PE	0.368	0.37 ***	0.421	0.47 ***
IQ -> PE		0.32 ***		0.26 ***
SQ -> PU	0.560	0.08	0.621	0.10
IQ -> PU		0.31 **		0.40 ***
IQP -> PU		0.15		0.10
IQS -> PU		0.11		0.02
PE -> PU		0.17		0.27 ***
SP -> PU		0.15		0.09
IQP -> SP	0.565	0.49 ***	0.507	0.29 ***
IQS -> SP		0.34 **		0.47 ***
IQ -> PEN	0.334	0.20	0.395	0.19 **
IQP -> PEN		0.07		0.20 *
IQS -> PEN		0.06		0.01
SP -> PEN		0.36 ***		0.36 ***
PE -> INT	0.486	0.31***	0.557	0.19 **
PU -> INT		0.11		0.43 ***
SP -> INT		0.04		0.21 ***
PEN -> INT		0.56 ***		0.43 ***

*** p< 0.001; ** p<0.01; * p<0.05

Implications of this study

The results of our study indicate some significant implications for both online encyclopedia as well as UCC platform providers. Overall, this study empirically confirmed that the user behavioral models differ for distinct user types (Wikimembers and non-Wikimembers). For this reason, we suggest that UCC website managers should compose specific strategies for active creators and passive lurkers as following descriptions.

Among Wikimembers (active creators), perceived ease of use and perceived enjoyment had significant direct effects on intention to use. From a technical perspective, system and information quality are the important factors increasing users' perceived ease of use. We consider that the major activity of Wikimembers is creating content, hence, information quality is like the guiding principles of creating / editing and can improve perceived ease of use. Moreover, although information quality significantly affected perceived usefulness, perceived usefulness had no significant effect on intention to use. The results showed that Wikimembers' perceived ease of use is more important than perceived usefulness. From the social viewpoint, platform function and the sociability function of interactivity quality are important factors for enhancing Wikimembers' social presence. This suggests that Wikipedia is a form of Web 2.0, one that especially emphasizes the interactive characteristic. Therefore, information exchange and interpersonal interactive functions can strengthen users' social presence. Although social presence had no significant direct effect on intention to use, it played an intermediate role reinforcing intention to use. The findings of our research reveal that the influence of perceived enjoyment was stronger than perceived ease of use, so the antecedent factor of perceived enjoyment—interactive quality—must be particularly respected.

For non-Wikimembers (passive lurkers), perceived ease of use, perceived usefulness, social presence, and perceived enjoyment had significant direct effects on intention to use. From the technical perspective, system quality and information quality are the important factors increasing perceived ease of use, while information quality and perceived ease of use significantly affected perceived usefulness. In addition, perceived ease of use not only had a direct significant influence on intention to use, but also indirectly affected intention to use through perceived usefulness. From a social viewpoint, the platform and sociability functions of interactive quality are important factors enhancing non-Wikimembers' social presence. Unlike the behavioral model for Wikimembers, social presence in the proposed model of non-Wikimembers not only indirectly affected intention to use but also had a significant direct effect. At the same time, non-Wikimembers mostly browse, respond, and revise information, and therefore, information quality and the platform function of interactive

quality positively affected users' perceived enjoyment, promoting intention to use. The results of our study for non-Wikimembers indicate that perceived usefulness was the most important factor influencing intention to use; perceived enjoyment was second. Therefore, website managers must pay considerable attention to the antecedent factors of perceived usefulness, perceived enjoyment, information quality, and interactive quality.

Limitations

The study has a few limitations regarding the research findings that should be considered. First, in this study we selected Chinese Wikipedia users as the target population, because Wikipedia has been developed in many languages, and hence the results might overlook "cultural diversity" among different countries with the same business model. Second, even though we have compared the analytical results according to the different roles of Wikipedia users, those with the same role might have distinguished the purpose-driven of users and caused different results.

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ALLIANCES AND ACQUISITIONS IN HIGH VELOCITY ENVIRONMENTS: IN SEARCH FOR A GROUNDING THEORY

Hani Sarkis, University of Quebec in Montreal, Canada
sarkis.hani@courrier.uqam.ca
Dr. Michel Plaisent, University of Quebec in Montreal, Canada
plaisent.michel@uqam.ca
Dr. Prosper Bernard, University of Quebec in Montreal, Canada
bernard.prosper@uqam.ca

ABSTRACT

Research and practice have documented that alliances and acquisitions are frequent in high velocity environments such as the high-tech industries. There are causes that lead the firms in this sector to use alliances and acquisitions and effects that influence the firm's innovative capacity, R&D and performance. This theoretical research, a work in progress, although not studying those causes and effects, explores some grounding theories used in the field of strategic management, to explain the possible rational behind the alliances and acquisitions' activities, from a theoretical view point. The research provides an in-depth review of the transaction cost economic and agency theory, resource-based view, and network theory and intends to utilize each of them to explain alliances and acquisitions. In doing so the paper is a first step toward integrating the different theories pertinent to the study of alliances and acquisitions, using a more holistic approach to the study of strategic issues, without neglecting the analytical approach.

Keywords: Acquisitions, alliances, transaction cost economics, resource based view, network theory

INTRODUCTION

The high technology industry is different than any other industry. It is characterized as a high velocity and high uncertainty environment. This is mainly due to the high rate and intensity of R&D in both the horizontal and vertical dimensions of the industry, the knowledge dispersity, the continuous emergence of new technologies and disruptive technologies [19, 20, 83], the high rate of technology obsolescence, the nature of the market that is changing continuously, the high degree of market, technological, and competitive uncertainty [6], the critical issue of timing and time to market and the lack of strategic assets that are complex and socially embedded in the skills, tacit knowledge, routine and culture.

Since the 1990 there was a substantial increase in alliances, joint ventures and mergers and acquisitions activities in the high technology industry. More than 11,000 acquisitions were completed in 1997 for a value estimated at over US$ 900 billion [17]. Some companies, like Cisco Systems in the data networking industry, underwent 18 acquisition in one year alone and over 94 acquisitions in a period of seven years. They developed a strategy called Acquisition and

Development or A&D, which is a combination of acquisition activities for external sources of innovation, while maintaining the internal innovative capacity of the firm [55].

Research in the field covered the management objectives in mergers and acquisitions [85], and their effect on R&D [41, 44], and on corporate control and innovation [42], and the effect of inter-organizational alliances on innovation [79], and performance [37], the disruptive technologies and corporate venturing [31] and the alliances as a surviving tool in uncertain environments [27].

However, in most of the research on corporate mergers and acquisitions, they are viewed as strategies for corporate control and empire building, and they are dealt with using a financial and economic perspectives, while neglecting their social, strategic and organizational dimensions [55]. In the context of the high tech industry characterized as turbulent, high velocity and high degree of uncertainty, no one company could possess all the required resources needed to compete and to sustain competitive advantage. The cost of R&D is very high, the learning curve very steep and the technology and product life cycle are very short [27]. This makes it difficult to rely only on internal R&D and innovative capabilities for sustained competitive advantage.

The research focusing on the high tech industries show that acquisitions are motivated by the need to obtain critical resources for the survivability of the firm or for sustaining competitive advantage, instead of the conventional explanation of gaining market share, expansion and economies of scale [71]. Those resources include R&D capabilities, innovative products, new technologies, skilled human assets, top management and entrepreneurial expertise, tacit and specialized knowledge and know-how.

One definition of acquisition in this context is “when a larger firm combines its capabilities in commercialization, manufacturing, distribution and innovation, with the product innovation capabilities of smaller entrepreneurial firms” [70]. Thus acquisitions enhance the technological capabilities of the acquirer, as those capabilities are embedded in the tacit and socially complex knowledge of the acquired firm [71].

The research in this field has documented that acquisitions are used in combination with alliances, in a way that alliances are a pre-acquisition phase and a testing and exploring ground for an acquisition and integration phase [55]. It starts by identifying the firm’s internal needs (***resources***) and assessing the potential players for alliances or acquisitions in the strategic group within the industry, by means of continuous scanning of the competitive environment [17]. During this scanning of the environment, informal relations (***links***) are established with the objective of identifying and evaluating potential emergent new technologies and innovation, assessing human assets (***resources***) involved in those activities and estimating the real economic value (***cost***) of these resources, in terms of technologies and human capital.

Some time the strategic value of some technologies, innovative capabilities and human capital is easily identified by the larger firm, due to the clarity of pattern in this emerging technology and its potential value in the future, or due to the unrestricted access to the entrepreneurial start-up firm’s internal information, motivated by their mutual interest in finding a partner or an acquirer for access to capital, management expertise, distribution capabilities or brand name. After this

process of informal relation and networking, then the decision is taken to acquire the smaller firm, based on strategic considerations such as fit and synergy. In other cases when dealing with smaller or equal sized firms, it is difficult to immediately identify a future wining technology or it is difficult to evaluate the companies' internal information because of the danger of leakage of proprietary information with regard not only to technologies, but also resources, processes, etc. Then in this case, the decision could be to use alliances or joint venture as a temporary form of cooperation.

But how does the decision of using alliances, joint venture, mergers and acquisitions take place? What is the real mental process of the decision-making, the rational behind taking a decision and choosing between one strategy and the other; between acquisitions and alliances? This theoretical research explains the strategies behind alliances and acquisitions in high velocity environments, by exploring different theoretical perspectives and trying to identify the pertinence of theoretical grounding to the study of alliances and acquisitions.

Furthermore, the paper uses a holistic and integrative approach to the study of alliances and acquisitions, by trying to integrate and combine different and distinct perspectives into a larger theoretical model, using the transaction cost and agency theory, the network theory and the resource-based view, while maintaining the depth of analysis that could be used in an analytical approach, without neglecting the details, coherence and the relation to practice.

This research intends to fill a gap in the area of alliances and acquisitions research and to contribute to the field of strategy and the research on the high-technology industries.

LITERATURE REVIEW

This section starts by reviewing the network theory, followed by a review of the resource based view and finally the transaction cost economics and the agency theory.

Network Theory

The network theory could be related to others organizational theories. "The stakeholder theory could be regarded as a special case of network theory. Transaction cost economics does not deal with the network as a subset of one or several markets. The industrial organization theory deal with competing firms in a market and could be seen as a case of attenuated network theory." The network paradigm is not a substitute to any other theory, but could be viewed as a supplement, with normative and positive implications [82]. From a network theory perspective, the entire economy may be defined as "a network of organizations with a vast hierarchy of subordinate criss-crossing networks", in which a network consists of "nodes" or the firms' positions and "links" manifested by the interactions between the positions, which has an important significance similar to the analogy of product positioning.

Entire networks could be founded as information utilities, concerned with the distribution of scarce resources, money and authority, where information and power is more valuable than money [82]. A position is a location of power to create and influence networks and it depends on the domain (mission) of the firm, its position in other networks and its relative power compared

to other network's members. For example the firm centrality in various networks could positively influence its ability for entering new alliances [34]. Links involve economic performance, technology transfer, diffusion of know-how and expertise, building trust, flow of legitimacy and they reflect the notion of interdependence. The boundaries around networks and firms are flexible and they adapt to environmental changes such as new regulations and emerging technologies. Vertical integration, is considered a result of "network failure" similar to the analogy of market failure [82].

Networks are in-between forms between markets and hierarchies. Strategic issues included in a network theory perspective include barter and reciprocal trading, make or buy decisions, split and unified sourcing, transactions between divisions of a company, cartels, interlocking directorates, joint ventures, mergers and acquisitions, diversification, internalization and vertical integration [82]. Research on the influence of social networks covered inequality, embedding, contagion and contingency [13]. Inequality explains the differences in resources among individuals, firms and groups, embedding describes the institutions and identity resulting from networks, contagion explain behavioral conformity in technological and social information and its influence on innovation and contingency suggest that social networks have an impact on organizational processes [34]. The networks can produce differential informational advantages through relational embeddedness or cohesion perspectives, in which direct connections between actors are a result of common knowledge of each other and structural embeddedness or positive perspective in which the information is transferred not only between the tied actors but also through the structure of the network and control benefits resulting from advantageous positioning with the network, such as being the "tertius gaudens" or situated between two actors. Informational advantage facilitates the creation of new alliances by means of access, timing and referrals. The structural embeddedness influence the choice of partners in alliances, where the status of the firm has a significant importance in term or attractiveness and visibility [34].

Embeddedness. The issue of embeddedness is an important one in the network theory as it increases trust and understanding, reduce opportunism as a barrier to resource exchange and mitigate search cost in obtaining resource information [33]. One definition of embeddedness is "*the fact that exchanges and discussions within a group typically have a history, and that this history results in the routinization and stabilization of linkages among members. As elements of ongoing social structures, actors do not respond solely to individualistically determined interests, a structure of relations affects the action taken by the individual actors composing it. It does so by constraining the set of actions available to the individual actors and by changing the dispositions of those actors towards the actions they may take*" [54]. Underlying embeddedness is the quest for information, to reduce uncertainty and how economic actions influence the social structure of ties within which they are embedded [33]. The social context in which the firm is embedded include structural, cognitive, institutional and cultural elements[92]. The distinct social structure within markets influence the flow of information [8, 87], which in addition to understanding the nature and purpose of the network, reflects the importance of social networks [78]. By influencing the access to information about potential partners, social networks could facilitate or restrain the firm's opportunity to identify potential and viable alliances.

Trust. An implication of the embeddedness of firms in social networks is the increase in trust, where partners will have the confidence that exploitation will not take place. This could take the

form of knowledge based trust, which a strong cognitive and emotional bases [34]. Trust is built on reputation, by personal friendships and social bonds and is manifested by interdependence [82]. Trust has a positive influence on resource sharing, which reduce opportunism. It helps to reduce technological uncertainty and to increase commitment [59]. Trust is enhanced by the cooperation and negotiation between partners in managing alliances and networks [32]. Trust relationships constitute the firm's social capital, beside its reputation in the industry and the community [43], which is an important basis for competitive advantage [35]. On the other hand opportunism and self-interest as being defined the motivators for economic activities [88], could be reduced by increased trust and commitment, the history of cooperation and through the administrative form of alliances using government structure [28].

Power. Power (and politics, to the other extreme of trust), is an important issue in embeddedness. It is usually seen as possessed unilaterally, but could also be of interdependence. The inter-organizational network could be conceived as a political economy based on the flow of power and the distribution of information. The sources of power for a network participant include economic power, technology base, expertise, trust and legitimacy. Some indicators of economic power are market share, size, and centrality of the seller product to the buyer core activity. The source of the buyer's power are the number of alternatives of supply sources, the less transaction costs for switching, relative liquidity, ability to extend credit and to integrate vertically. Other sources of power could be superior technology, product and process innovation, quality, flexibility, expertise, capabilities in R&D and engineering and pre and post sales services. [82].

Governance. The network theory covers the areas of strategic alliances and joint ventures. Joint ventures are temporary forms of organizations categorized as hybrids, which provide quick response in real time. They facilitate timely entry as timing is critical in a high velocity environment and when learning by doing is important [89]. As in alliances, they are motivated by learning, technology development, market penetration, access to capital [47], and they are prevailing in some industries [57]. Regarding the governance structure, joint ventures involved partners creating a new entity in which they share equity and hierarchical control, while alliances are formed with no equity sharing and few hierarchical controls [34]. In joint ventures, the ability to share knowledge and implement may vary based on the administrative form and governance structure. The equity form stresses issues of control, governance, setting targets and measuring progress. The hierarchical form provides a structure to absorb tacit knowledge that is not easily codifiable or transferable, to reduce moral hazard and adverse selection [28], and the reduce and control the danger of appropriation. The greater the appropriation concerns, the more hierarchical the governance structures [34]. In alliances, non-equity forms provide a better way to discover knowledge and day-to-day cooperation. This is important early in the alliance, when it is difficult to evaluate the partner's information and the potential future value of the knowledge gained by the alliance [57]. Alliances between a large firm and a start-up, with little information known about it, allow the firm to evaluate the information about its partner technology, human and financial assets, in order to determine if there is a strategic fit.

The Resource-Based View

In the field of strategy, the term defined by Andrews [4] as the internal strengths and weaknesses of the firm, reflects on the resource base of the firm. The firm is seen as a broader set of

resources [58]. In the resource-based view, the approach is on the internal accumulation of assets, with the nature of those assets in term of assets specificity and to a lesser extent to the transaction cost [60]. In relation to the other fields and theories of strategy, the resource-based view incorporates concepts from strategy research, it fits within the conversation of organizational economics and it is complementary to the industrial organizational analysis, with both the Harvard and Chicago schools [52]. However, the resource-based view places the resources at the center of competitive advantage and therefore performance [86], and it shifts the focus from cost, as in transaction cost economics, to value. Value is created by the synergies of bundled resources [43]. Those resources could be internal, external or a combination, which reflect the issue of boundaries [60].

Using the resource-based perspective, the key issues addressed when formulating a strategy regarding alliances and diversification are: The resources based on which the diversification should take place; the resources which should be developed through diversification and alliances; the sequence and the markets for diversification and the criteria of attractiveness of the potential firm to be acquired [86]. Rent generation resources could be external or internal and could depend not only on market imperfection, but also on unique historical circumstances such as a valuable physical location, or the accumulation of specialized capabilities [56].

Institutional and population ecology approaches to RBV. Relating the resource-based view to the population ecology theory, the diversity of internal capabilities will increase the survivability of the firm, by helping the firm to cope with the uncertainty of the future [2, 39]. From the institutional theory perspective, the selection of resources and sustainable competitive advantage are influenced by the institutional context, such as the rules, norms and beliefs, which surround the economic activity of the firm [56]. The resource selection is based on the internal decision making influences on the individual level such as cognitive, sunk cost and conformity to tradition, on the firm level such as the corporate culture and politics, on the inter-firm level such as the state and inter-firm alliances, and on strategic external factors, which influence the selection such as the buyer and supplier power, the intensity of the competition and the industry and market structure [56]. The selection of resources could produce barriers to acquisitions, imitation and substitution, which creates strategic market imperfections such as resource mobility barrier acting as an isolating mechanism [56, 73].

Isolating mechanisms [73], mobility barriers [66] or entry barriers [7], protect the firm from imitation and preserve their rent. Those could be traits in the resources such as tacit knowledge, uniqueness, invisibility, complexity, path and time dependent [11, 26, 50, 60]. Other isolating mechanisms could be buyer switching costs, reputation, channel crowding and economies of scale [74]. Casual ambiguity prevent imitators from identifying what and how to imitate strategic resources [50].

Characteristics of resources and heterogeneity. Beside the isolating mechanisms, the resource characteristics are whether the resources are scarce, unique, inimitable, durable, idiosyncratic, non-tradeable, intangible, non substitutable [3, 11, 60], valuable and rare [50]. Resources that are rare, imitable and create value are categorized as strategic resources [18]. Also strategic resources could be an experience top management team [14, 24] or a group of R&D researchers, as valuable idiosyncratic human assets, who possess specialized knowledge, which can help in

reducing cost, improve quality, and innovate, all sources of competitive advantage [23]. Those non-tradable assets are difficult to imitate because they have a tacit dimension, are socially complex [26], time dependent and path dependent, which give the firm who possess them an informational advantage [60] and should be identified and sustained [10].

The resource-based view focuses, as stated by Oliver [56] on "the characteristics of the resources and the strategic factor markets from which they are obtained to explain firm heterogeneity and sustainable advantage". The idiosyncratic human, physical and intangible assets create heterogeneity [52], which is one of the conditions for competitive advantage, and if preserved, create a sustained competitive advantage [60]. The resource-based view assumes that the resources and capabilities across firms are heterogeneous, and some that are superior to others achieves economic efficiency and rent streams [11]. Homogeneity, on the other hand, could result from strategic alliances, regulatory pressures, human capital transfer, social and professional relations and competency blueprints [56]. So alliances could be a source of homogeneity, as it could be a source of heterogeneity, if used to access superior resources not available internally. Acquisitions are a source of heterogeneity as they allow the firm to acquire resources leading to competitive advantage.

Resources and capabilities. Some authors make a distinction between resources and capabilities: Capabilities are skills based on human competencies and "capacities to coordinate and deploy resources to perform tasks", while resources are all other assets [53] and "input factors used by the firm to develop and implement their strategies" [3, 56]. Capabilities could be dynamic, referring to the firm capacity to renew competences to adapt to a changing environment. They require timely response, rapid and flexible innovation, which is essential when time to market and timing are important, especially in the context of a high rate of technological change and when the uncertainty about markets and competition is high [81].

As the firm is portrayed as a bundle of resources [58], they comprise all the firm assets and capabilities and constitute the company's strength and advantage [69], or its weakness [86]. The firm's resources could be tangible and intangible [15] and are semi-permanently tied to the firm. To give some examples; brand names, in-house knowledge and technology, employed and skilled personnel, trade contract, machinery, efficient procedures, R&D expertise, capital, etc. [86]. Those resources influence the firm's growth and its rate, if they are used to expand into activities related to those resources [24]. Resource differences among firms could explain the performance differences and resource scarcity could lead the firm to engage in inter-firm cooperation such as alliances or to acquire those needed resources in the market [52]. The sustainability of these differences depends on the difficulty faced by competitors in accessing similar resources [11, 26]. Whether home grown or acquired, those resources that lead to high profits could be called "resource position barriers" as in analogy to entry barriers, since one competitor will have an advantage [86]. Those entry barriers are isolation mechanisms.

Because the history of the firm engender its routines based on which strategies are formulated and actions are taken, the organization's resources and capabilities could be a source of competitive advantage or a constraint [51]. The valued resources and capabilities that contribute to competitive advantage, are defined as strategic assets, and they could be built up through cumulative experience and learning-by-doing or acquired from factor markets [3], with the

probability to be motivated by collaboration more than by transaction cost economizing [51], and as in the case of alliances and acquisitions, for resources that cannot be built internally with acceptable cost, risk and within acceptable time [29]. In addition, built in resources are subject to difficulty in measurement as a determinant of governance performance, based on the principal-agent theory, due to moral hazard and adverse selection [28].

Competitive advantage. The strategic assets create a competitive advantage based on four conditions: heterogeneity, ex-post limits, imperfect mobility and ex-ante limits [60]. Ex-post limit could be limited by imperfect imitability and imperfect substitutability [61]. Imperfect imitability could not be achieved if the innovation is an assembly of available technologies, and which patent protection would not be a sufficient barrier. Imperfect mobility depends on the value of the innovation or resource which cannot be revealed because it is proprietary and for fear of appropriation [60]. With all those conditions met, the strategic assets are the core competencies of the firm and the source of sustained competitive advantage [68].

When the firm needs additional assets, whether to complement existing ones or for reason of scarcity, alliances and acquisitions occur. Alliances are seen as a quick inexpensive external growth method, as studies show that financially weak firms tend to use alliances, while financially strong firms tend to acquire [43] and as "learning races" favoring the partner that learn more quickly [38, 46]. The issue of resource endowment has an influence on all inter-organizational relationships, which are used by the firm to access, control and share resources external resources needed to overcome growth constraints [38], which in the same time require internal resources such as capital, management, experience [43], and the ability to learn and adapt known as absorptive capacity [22].

Transaction Cost Economics and Agency Theory

The firm is described as a nexus of contracts, suggesting that the firm not different that the market in contractual aspects [30, 45]. The transaction cost theory distinguishes three forms of economic organization; markets, hybrids and hierarchies. Each form of economic organization uses a different type of contract law; classic contract law, neo-classic contract law and relational contract law, respectively. Each utilizes a distinct governance structure; market governance, trilateral or bilateral governance and unified governance or vertical integration, respectively. This ultimately determine the boundaries of the firm [88].

Asset specificity, frequency and uncertainty. The transaction cost approach to the study of organizations covers issues ranging from varieties of organizational structure to franchise contracting [5, 88]. The definition of a transaction is "the transfer of goods or a service between technologically separate units and the analysis of transactions focuses on achieving efficiencies in their administration" [89]. The critical dimensions or criteria of a transaction are the frequency with which it occurs, the degree of uncertainty it involves and the degree of asset specificity it involves [88]. Depending on the frequency of the transaction, the efficient governing structure for the efficient use of resources will depend on the degree of uncertainty (which is high in high velocity environments) and the specificity of the assets involved in the transaction [84, 88]. Asset specificity has reference to "the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value". It could be site specificity,

stations located nearby to economize on transportation and inventory; physical assets, specialized tools to produce a component; human asset specificity, learning by doing and know-how; dedicated assets, investments; brand name capital; and temporal specificity, technological non separability in which time response is critical. Assets specificity increases the cost of governance, which could be offset by cost savings and increased revenues. The ownership of assets is related to the property rights: the right to use the assets, appropriate the returns and to change the form of the asset [89]. Transaction costs are assessed indirectly by measuring the degree of asset specificity and uncertainty associated with the buyer supplier contract [84].

Vertical integration and acquisitions is a demonstration of market failure [88, 89]. When faced with market failure, the two parties searching for complementary or supplementary resources would internalize their transaction by adopting alliance, joint venture or merger and acquisition. In case of an acquisition, this contribute to the transfer of specialized tacit knowledge to the acquirer and of access to capital to the acquired [72]. The decision to use alliances or acquisitions depends on several factors among them, opportunism, governance, and safeguards against appropriation. If the danger of opportunism and the safeguards to protect individual interests are high with high asset specificity, then internalization is favored to reduce costs. If the cost of integrating the economic activities of the combined entities is higher than the expected synergy potentially resulting from the integration, then alliances are favored over acquisitions [43]. As the sustained competitive advantage of the firm is based on the procession of strategic assets and core competencies [68, 86], the boundaries of the firm determines the composition and possession of those resources [65].

Governance. The choice of governance structure has an implication on the nature of the contract and the mechanism to resolve conflicts and disputes, which influence costs. Neo-classic contract form is used when parties maintain certain autonomy and they remain bilaterally dependent and engaged, such as in alliances and joint ventures. Bilateral monopoly uses relational contracting, and it is when the two parties engaged with a commitment for long-term due to the nature of their respective large investments occurring over a large period of time, with no fast returns. This engagement limits their agreement or collaboration with others.

Whether the transaction is based on make or buy, internal procurement or market procurement, will have an implication on the means of dispute resolutions, whether arbitration or litigation. In neoclassic contracting the mean for dispute resolution is through arbitration and not litigation, which in case of alliances and joint ventures, as bilateral monopolies, reduces the cost of litigation, the time of conflict resolution and increase the contracting flexibility in managing uncertainty [88, 89]. In the case of acquisitions, the implicit law of resolving conflict is that of forbearance and business judgment rule. This allows managing internal dispute without going to court, which reduce costs, time of conflict resolution and increase trust [89]. The internal organization of economic activities or acquisitions reduces the internal incentives compared to market incentives and reduces the difficulty in measuring behavior. However, the incentive deficiency and measurement difficulty could be reduced by outcome based contract and equity sharing, which curb the opportunism, deal with moral hazard and adverse selection, and transfer an amount of risk to the internal agent which help align its goals with that of the principal [28].

IN SEARCH OF A GROUNDING THEORY FOR ALLIANCES AND ACQUISITIONS

Strategic Alliances

Strategic alliances are defined as "a voluntary arrangement between firms involving the exchange, sharing or co-development of products, technologies and services". Some of the decisions taken by the firm are the choice of the appropriate partner, the choice to enter into an alliance, the choice of the alliance's structure and the dynamic evolution of the alliance. The unit of analysis is the firm or the alliance [35]. From an economic perspective strategic alliances capitalize on specific advantages in firms, markets and industries. Industries with high R&D rates have a higher proportion of alliances, which result in higher savings. In international business, they are temporary form or hybrids, for expansion, penetration, cost and risk sharing. From a corporate strategy perspective, alliances are used for learning, technology development, and market penetration. Alliances are viewed as a learning conduit and process. They support the firm to improve its know-how, capabilities and tacit knowledge. The process of learning within alliances is more complex than in hierarchies, however, alliances provide a faster response to R&D challenges when timing is critical specially in a high velocity environment, with a degree of uncertainty [57].

From a transaction cost perspective, alliances are placed on a continuum between hierarchies and markets [72, 82, 90] with a hybrid form of governance [28, 88]. They help to reduce the net cost of conducting business, however one of the shortcomings of the transaction cost approach to alliance analysis is the focus on the cost minimization by one party, while alliances are for exchanges between two or more partners. In fact alliances are not only about cost minimization, but also joint value maximization [91].

From inter-organizational and institutional approaches, alliances characterized collective patterns of survival, growth and sustainability [57]. Environmental pressures on the firm could lead to resource dependency [63]. The argument is that at intermediate level of industry concentration, firms could experience high levels of competitive uncertainty and could moderate this competitive interdependence by entering into alliances [62]. The resource consideration is important as some firm use alliances to buffer and explore uncertainty [48]. Firms enter into alliances when they perceive a critical strategic interdependence with other organizations in the environment, where one firm possess capabilities not possessed by others [1, 49]. Because rapid changes in the environment could alter the needs of the firm, the later should identify their real needs and potential partners, otherwise it could be locked in a path dependency [34]. Alliances also are viewed as experiments in institution building to solve strategic problems and they allow the emergence of trust [57]. One driving force behind alliances could be isomorphism [40].

Alliances are used when the firms are faced with daunting technological and environmental challenges, such as the convergence of technologies and the emergence of new government regulations [57]. They provide an external source of innovation and R&D, and buffer from uncertainty, by sharing risks and adapt to change [72], reduce time to market by shortening the cycle of innovation [89], and leverage resources by means of horizontal and vertical alliances, which help to expand strategic capabilities and reduce competition [72]. The Japanese model of inter-organizational collaboration, alliances and joint venture is a good example. The issue of

technological uncertainty is critical as the emergence of new technologies could represent a technological paradigm shift, where in the area of high-tech industries, the rate of technology obsolescence is higher than other industries [72]. In their study, Hoffman and Schaper-Rinkel [43] found that strategic and technological uncertainty, disperse knowledge and converging technologies, and high level of inter-organizational trust, favor the formation of alliances in high velocity environment, which allows for the sharing of history dependent competencies [56].

Alliance formation depends on three motivation as transaction costs resulting from small number bargaining, enhancing market power and competitive positioning, and the quest for organizational knowledge [47]. The quest for market power may be an important motive [12]. The factors influencing alliance formation are the extent of competition, the stage of development of the market and demand and competitive uncertainty [34]. Attributes such as size, age, competitive position, product diversity and financial resources are predictors of the firm propensity to enter an alliance [9, 67, 76]. The condition of mutual economic advantage is necessary but not sufficient to enter into an alliance [34]. The extent of market overlap between the partner, or relative scope, could influence the likelihood of competitive dynamics between the partners [46]. The research on the relationship between the size of the firm and the decision to enter into an alliance are contradictory [72].

During the network phase, strategic alliance or joint venture, a market adaptation and coordination is used to coordinate investments and alignments. This could create through time, a bilateral dependency that paves the way for internalization. This bilateral dependency is a path dependency that leads to vertical integration through acquisitions [89]. Safeguards against opportunism and contracting hazards create a mutual dependency between the parties [72]. The danger of opportunism and the safeguard costs against appropriation, influence the decision to use alliances or acquisitions [43]. The danger of appropriation comes from the risk of one partner imitating the technology or the core competencies of the other and start competing [64]. The argument of the transaction cost approach in the case of alliances is the cost reduction, while dealing with market uncertainty and the risk of opportunism, which tend to increase costs [57, 84].

Acquisitions

Alliances could be seen as a first step before or towards acquisitions. As proposed by Hoffman and Schaper-Rinkel [43], weak appropriability regimes, high expected synergies and high resource endowment (specially financially) favors acquisitions over alliances. High synergy require a strategic fit between the acquired and acquirer's strategy, resources and organizational culture [86]. To achieve this fit, the acquisition strategy could be based on resources that are related supplementary (more of what the firm has) or related complementary (resources which combine effectively with what the firm has) [75]. The combination of supplementary and complementary resources produces synergy and lead to superior economic performance [77].

Therefore, acquisitions could be defined as a purchase of a bundle of resources in an imperfect market and to trade otherwise non-marketable resources [86], which are imperfectly imitable because of tacit knowledge and social complexity [26]. Social complexity is considered a general asset for the firm [21]. The resources which support diversification could be defined as quasi-

fixed, yet inherently fungible [60], and resulting from excess capacity, multiple use and market failure [16]. This bidding of firms based on strategically related acquisitions could produce abnormal returns [61], depending on the degree of relatedness among products and coherence in business activities and the scope of the firm including the speed of learning, the breadth of path dependencies, the degree of asset specificity and the nature of the selection environment [60]. Acquisitions achieve economies of scope such as sharing overhead costs, administrative and advertising costs, skills and resources such as inputs and technologies, relations such as customers and suppliers, generic resources and physical assets such as office building and equipments, risk, investments, knowledge and know-how and it reduce the learning curve [25]. This economies of scope and scale, achieve high gains through acquisitions in high velocity and high uncertainty environment such as the high tech industry.

Acquisitions and vertical integration are a demonstration of market failure [88, 89]. The problem of evaluating the supplier or the partner's (in case of alliances) performance, combined with the risk of opportunism, uncertainty and high asset specificity, favors the internalization of the transaction through acquisition. The coordination required in the case of alliances, between the in-house engineering or management team and the supplier or partner, becomes more complex under volume uncertainty, as fluctuation in demand and non-predictability and technological uncertainty, which favors acquisitions [84]. When the knowledge cannot be protected by law against leakage, then acquisition is favored [80]. Hoffman and Schaper-Rinkel [43] found that high behavioral uncertainty, risk of opportunism, moral hazards and adverse selection favors acquisitions over alliances.

The incentives to vertically integrate depends on the type of production involved, the extent of the transaction costs, the amount of specialized assets, the degree of market power, the separability of activities and the amount of uncertainty concerning price and cost. However, vertical integration could raise costs due to the complexity of managing the integration, which could lead to managerial inefficiencies. Mobility and exit barriers may increase strategic inflexibility, which leads to path dependency. Cost may be reduced by reducing transaction costs, decreasing uncertainty or asymmetry of information and by protecting proprietary technologies. Vertical integration could increase profits through higher prices by creating entry barriers, reducing service and advertising externalities. Acquisitions result in economies of scale and scope, such as sharing R&D expenses, resources, knowledge and relations. Economies are achieved by coordinating and reducing production and inventory costs, transportation costs by using the same location, and by the opportunities to exploit technological interdependency [25].

DISCUSSION

In the analysis of alliances, acquisition and make-or-buy decisions, the transaction cost approach focuses on the cost of the transaction, the resource based view focuses on the value of the resources and the network theory focuses on the informational flow, and the risk of appropriation. The strength of the firm in transaction cost is based on economic efficiencies, in the resource-based view on core competencies and strategic assets and in the network theory on position within the network, trust, and power. The unit of analysis is the cost in transaction cost; the firm or resource in the resource based view and the link or position in the network theory. Opportunism and uncertainty are reduced by trust in network theory, by governance structure in

transaction cost and by collaboration, fit and synergy in the resource based view. The distinction between cost and value is critical since it causes a fundamental shift in the approach towards governance and the analysis of decisions related to the firm's boundaries. Transaction cost focuses on market failure, network theory on network failure and the resource based view on limits of the firm capabilities and hierarchical failure. Transaction cost focuses on the exploitation of the firm's advantages, network theory on the exploitation and development of the firm's relations, and the resource based view looks at the development of such advantages. Transaction cost and network theory are driven by the assumption of opportunism and bounded rationality and resource based view by bounded rationality only. The choice of the firm boundaries has an impact on the transaction cost, the transfer and flow of knowledge and the firm's internal and external capabilities. The distinction between value and cost has an influence on the internalization and the collaboration decisions. The governance structure is distinct and has different implications in transaction cost, network theory and the resource-based view. The mechanism used in dealing with opportunism is distinct in each case. Transaction cost, the resource based view and the network theory, explain the rational behind the alliances formation and the acquisitions of external resources for sustained competitive advantage. However, when applied to an environment characterized by a high degree of uncertainty and high velocity such as the high tech industry, it seems that the network theory is more suitable to explain the process of scanning the environment, forming alliances and joint ventures, while the resource based view is more suitable for explaining the use of acquisitions, as it conceptualizes the decision making based on the lack of critical resources and the need to access or acquire in a timely fashion tacit knowledge which is difficult to buy. The choice of the governance structure has an important effect on the firm performance. The choice between transaction cost, network theory and the resource-based view is a choice on the firm boundaries, as the choice between cost and value would determine the boundaries of the firm. The role that technological uncertainty has on governance performance and optimal boundaries is not clear. Increases in technological uncertainty have no effect on performance, making it unclear how the comparative performance of such activities affects the boundaries decisions.

The field of strategy is a complex one. It includes all the functions of the top executive, with the underlying divisional fields of marketing, finance, etc. It is also grounded in behavioral science, political science, anthropology, sociology, psychology, economics and finance. It combines different disciplines such as business policy and strategic management, industrial organization, organizational economics, economics sociology, human behavioral science, organizational theory and others. It use different theories borrowed from distinct areas of social science to interpret and explain the issues under investigation, such as transaction cost, resource-based view, network theory, knowledge-based view and market-based view.

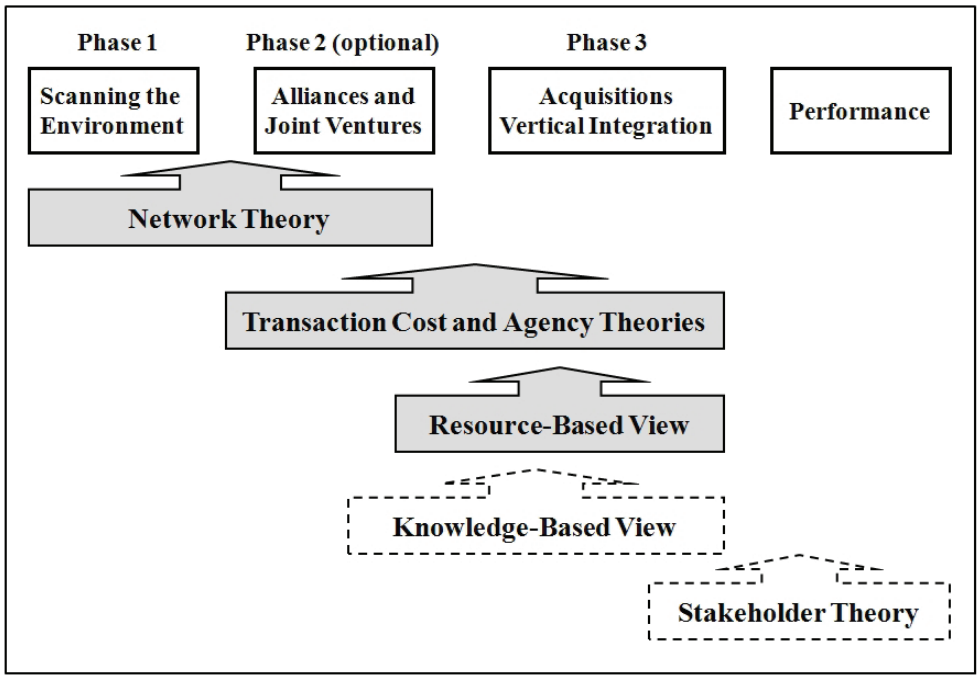
However, the issues under investigation are much more complex than they seem when using one or another approach to explore them. As Hafsi and Thomas [36] noted, "*collective action cannot be understood if it is broken down into parts to be studied separately, As reality is complex, it is more appropriate to study it in its totality. This means not only studying all the parts together but also their inter-relationships, even if the result is an incomplete and imperfect understanding*". Furthermore, using the holistic approach alone for integrative purposes is considered to be outdated and not scientific and less credible because of the use of qualitative methods, while using the analytical approach alone tend to fragment the reality into unrelated (or less related and

integrated) pieces, and tend to see strategy as an assemblage of theories and methodologies; *"…The question of what strategy is. It feels like a vast array of diverse and uncoordinated detailed observations that are scientifically respectable, yet incoherent in practice.*" [36]

Even before reading Hafsi and Thomas, and in the planning stage of this paper, I was guided by my intuition to use a holistic approach to explore the issue of my interest, alliances and acquisitions in the high-tech industries, with the intention of integrating, if pertinent, the different theories into a theoretical model that could be used to explain the object of my investigation, acquisitions and alliances in high velocity environments, and most importantly without neglecting the details and their implications to practice in real life and corporate decisions making.

My understanding is that, in studying alliances and acquisitions, more than one theory should be used in an integrated approach with a clear definition of its theoretical foundations, assumptions and boundaries, within the scope of the investigated object. After exploring the different theories included in this paper, the theoretical model represented in figure 1 emerged. It combined the network theory, the transaction cost and agency theory and finally the resource-based view, with a temporal assumption reflecting the different phases of alliances and acquisitions: Pre-acquisition, acquisition decision making, post-acquisition and performance measurement.

Figure 1
Integrative theoretical grounding model for alliances and acquisitions



In the context of the high-tech industry, the network theory is more pertinent to the pre-acquisition phase, where the firms are scanning the environment based on their relations and searching for potential partners for informal collaboration, strategic alliances or joint venture.

This is usually done in an exploratory and test mode, for future acquisitions. The boundaries for the use of the network theory are clear; before taking the decision for internalizing the activity through acquisition. The transaction cost and agency theory deal with organization forms (alliances, joint ventures, or acquisitions/vertical integration), the cost involved in each mode (market, hybrid or alliances/joint venture and vertical integration/acquisition), and the governing mechanism for each structure. Thus, those combined theories are pertinent at the boundaries of the scanning phase, during the alliance/joint venture phase and the acquisition phase. The theoretical boundaries of their application cover the three areas. Finally the resource-based view concerned with the acquisition and accumulation of strategic assets and core competencies for sustained competitive advantage, is more pertinent to the acquisition and integration phase. However, in evaluating external complementary and supplementary resources, it also covers part of the alliance/joint venture phase. Therefore, its coverage area is the acquisition phase and part of the optional alliance phase, and its boundaries are fixed on the acquisition phase and flexible in the optional alliance/joint venture phase. In the context of acquisitions, alliances with their different contractual and non contractual forms are optional. Some cases would encourage the use of transitory alliances [27] before taking the acquisition decision, to evaluate closely the potential acquisition target and overcome information asymmetry. In other cases, the decision to acquire is made without the need for any pre-acquisition formal or informal cooperation, such as alliances and joint-ventures.

Finally, the knowledge-based view, the market-based view and the stakeholder theory could be integrated into the theoretical model; however they were not part of the scope of this research. Their tentative position is planned for further exploration as shown in figure 1.

IMPLICATIONS

This work in progress has several implications for scholars and practitioners. For practitioners, it describes the environment and the context of acquisition decision making in a high velocity environment, and the phases prior to making the decision (scanning and due diligence) and the subsequent phase of integration. It explains the complexity of the factors involved in each of these phases and categorizes them using three distinct lenses: Transaction cost economics (and agency theory), resource based view, and network theory. Those various factors with their underlying theoretical lenses are closely linked and, by using cognitive simplification, are reduced to three key decision areas: Resources, links, and cost. Before contemplating an acquisition, the key decision maker or the acquisition team, would have to evaluate their internal and external resources, by identifying their needs, their existing capabilities and the potential resources in their firm's ecosystem. They would have to use their existing relationships within their ecosystem or establish new relationships, to link their needs with the external resources. Their needs could vary from assessing the external environment and evaluating potential targets, to informal or formal collaboration with competitors, through participating in standard bodies to enact the future direction of technologies and markets, or through venture capital, joint venturing or strategic alliances. In assessing the resources and establishing the links, the factor cost should be calculated. The cost and resource endowment could be influential in deciding between the decision for acquisition or alliance. The cost of internal R&D and of acquiring an external source of innovation could be decisive in a make or buy decision. The complexity of the integration in a post-acquisition phase could have serious implications on the overall cost, the efficient use of

capabilities and the efficiency of the governance structure. The three factors together, resources, links and cost, would have a large impact on the organizational structure and strategy, which would have serious implications on performance and the firm's ability to sustain competitive advantage.

The complexity of the tasks involved in acquisitions' activities within the context of high velocity environment, such as the high technology industries, lead us to believe that undertaking the decision to go for acquisition is a multi-level, multi-function and involving a temporal dimension as well. Those tasks cannot be undertaken by one key decision maker alone like the chief executive or by the executive team only. Cognitive simplification, bounded rationality, and asymmetry of information, would not yield to successful acquisition outcome. In addition, it would be highly impossible to manage such intensive acquisition activities, as in the case of the high technology industries, with this limited number of involvement. Instead, it would be highly probable, that different teams, from different department with different skills, are involved in managing the different phases and lifecycles of such intensive acquisitions' activities. The involvement of multi departmental teams would have an impact on the organizational structure and strategy formation within the organization dealing with intensive acquisitions activities. Dynamic capabilities would be a key success factor in managing an organization structure of this nature. This structure would reinforce the tendency to believe that the process of strategy formulation in such an organization is not an emergent one, but rather deliberate with long range planning. The involvement in intensive acquisitions' activities, such as in the case of the high technology industries, would lead us to believe that the firm has adopted deliberately acquisitions as a key strategy, if not the main strategy for growth and sustaining competitive advantage.

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ELECTRICAL MOTOR BUSINESS AND DIFFICULTY MANAGING DELIVERY

Rosemarin Sukhasem, Kasetsart University, Thailand
g4985025@ku.ac.th
Dr. Pornthep Anussornnitisarn, Kasetsart University, Thailand
fengpta@ku.ac.th
Dr. Petri Helo, University of Vaasa, Finland
petri.helo@uwasa.fi

ABSTRACT

Since manufacturer who did mass production encounter with many problems due to more business competitions, unpredictable demand and cost/resources/time constraints, the challenge strategy, mass customization was implemented. Often manager realize it difficult to decide which products to make-to-stock, assembly-to-order, make-to-order or engineering-to-order. These different manufacturing strategies will effect to time to delivery of raw material and product and effect to inventory level. Therefore, electrical motor businesses face against with this problem too. This paper presents how electrical motor firm managing customization. Major factor that electrical motor manufacturing consider are demand, lead time, cost, product characteristic and bill of material. Other factors are collected while comparing with three researches from food, pencil and plastic molding firms. We introduce inventory holding cost model that can be change with different customizations. Finally, we discuss about tools for making this decision for example: conceptual model, quantitative and qualitative model and future research opportunity with data mining procedure.

Keywords: Customization, Electrical motor industry, Make-to-stock, Make-to-order, Assembly-to-order, Engineering-to-order

INTRODUCTION

In a previous day, mass production strategy was very famous. Many manufacturing industries produced standard products guided by long-term forecasts. Manufacturers tried to produce a large number of products, because this can reduce manufacturing cost and can confirm that customers will get products as soon as they order. Products were stocked and waited for selling. Nowadays, manufacturers who do mass production confront with problems such as over stock, expired products, verities of customer's need etc. Because demand is rarely forecast correctly, companies miss potential sales and must pay to store and manage excess product. The companies lose sight of what customers really want and lose profits. Some customers request the manufacturer to do the design of product, so it takes long times for producing. But customers always satisfy fast delivery and good quality, thus Mass customization becomes important.

"Mass customization" is a manufacturing strategy that aims at best satisfying individual customer needs with near mass product efficiency and accommodates differentiated product attributes at low product cost. Mass customization is also concerned with quick

responsiveness. It also calls for flexibility in turbulent and changing environments by continuing to adapt for changing customer needs and in being able to supply these needs with high-quality and trustworthy products and services. Customer demands for both greater product variety and reduced delivery lead time, this is difficult for firms to achieve because quick delivery is usually based on standardization. Whereas, product variety requires the organization to be flexible and innovative. Thus, mass customization is an approach for a line of adaptable highly differentiated products. This strategy need flexibility of processes or product lines, thus all parts of product should be group in to modules which easy and fast to assembly.

To fulfill customer's order, firm have to consider WHWW detail: What product(s), How many, Where to deliver to and When to deliver. Usually, it's difficult to decide which products/parts should make to stock (MTS), assembly to order (ATO), make to order (MTO), or engineering to order (ETO). The decision for choosing which type of manufacturing pattern (the order fulfillment system) might affect to inventory level and holding cost. Each manufacturing type may have different inventory holding cost, depend on value and stock periods of raw materials and products. These manufacturing strategies all relate to different positions of the order penetration point (OPP) (Olhager, J., 2003). Furthermore, the OPP may differ between products and over time for a particular manufacturing firm. The electrical motor industry is our case study because of electrical motor has general structure, standardization and commonality bill of material (BOM) that will be good to be the general case study for motor manufacturing and may easy to compare with other industrial areas.

In this paper, first, the theoretical background of the studied problem will be introduce, then the actual decision making and specific characteristics of electrical motor manufacturing are presented. Next, three case studies (food, plastic molding and pencil) are shown and compared for the challenges and parameters. We introduce the idea of inventory holding cost model when customization was changed. Tools for decision making are discussed. Finally, the last section will present our conclusions and a discussion the paper's contribution and the future research opportunities.

Order penetration point/ Customer order decoupling point (CODP)/ Order fulfillment system

The order penetration point (OPP) is defined as the point in the manufacturing value chain for a product, where the product is linked to a specific customer order (Olhager, 2003). Sometimes the OPP is called the customer order decoupling point (CODP) to highlight the involvement of a customer order. Decoupling point (DP) is the point that indicates how deeply the customer order penetrates into good flow (Van Donk, 2001). The background of decoupling point related to a concept for integral control. Integral control is finding a balance in the costs of procurement, production, distribution and storage against the customer service to be offered. The result of this balancing establishes the decoupling point for a certain product-market combination. Different manufacturing situations such as MTS, ATO, MTO and ETO all relate to different positions of the OPP. The different manufacturing situations are related to the ability of the manufacturing operations to accommodate customizing or wide product range. Thereby, the OPP divides the manufacturing stages that are forecast-driven (upstream of OPP) from that are customer-order-driven (downstream of OPP).

Most important factors affecting the positioning of the OPP are Market, Product and Production characteristics (Olhager, 2003).

Market related factors (Mainly come from customer demands): delivery lead time requirement, product demand volatility, product volume, product range, and customization requirement

Product related factors: modular product design (is influence to ATO strategy.), customization opportunities (if the customization offered is wide and enters the product at early production stages, an MTO policy is necessary, whereas if customization enters at a very late production stage ATO may be more appropriate), and product structure (breadth and depth of the product structure indicates the product complexity and correspond to long cumulative production lead times).

Production related factors: production lead time (mainly factor and it respect to the delivery lead time requirements set by the market), the number of planning points or work centre in a manufacturing process (restricts the number of potential CODP positions), the other factors are flexibility of the production process (short set up time lead to making to order), the position of the bottleneck (upstream OPP bottleneck does not have to deal with volatile demand and variety of different products, leading to MTS. Downstream bottleneck would be best to Just in time principle that firm has customer order, leading to MTO), and resources with sequence-dependent set up time (best position at upstream the OPP).

To make a decision of OPP, two major factors are considering: (1) the production to delivery lead time ratio (P/D ratio), and (2) the relative demand volatility (RDV). Mather (1988) discussed about the P/D ratio, whereby P is defined as the production lead time, i.e. how long it takes to manufacture a product, and D is the demand lead time, i.e. how long customers are willing to wait for the order to be completed. The RDV is defined as the coefficient of variation, i.e. the standard deviation of demand relative the average demand. We can identify four basic situations as Fig. 1.

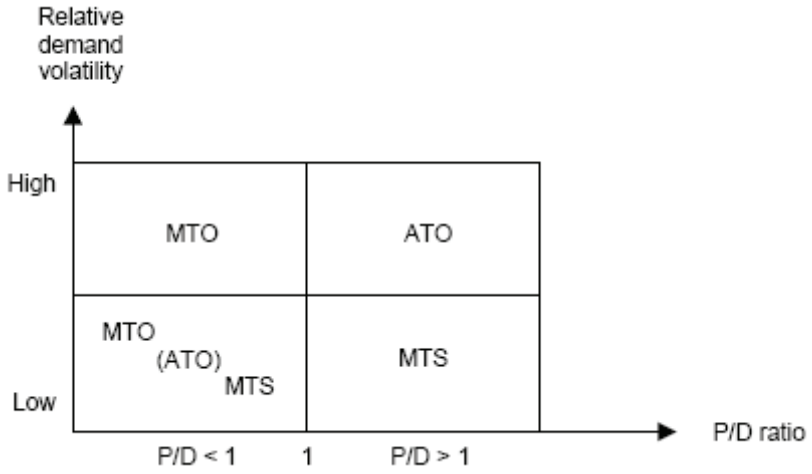

Fig. 1 A model for choosing the right product delivery strategy. (Olhager, 2003)

Value of P/D ratio less than one means production lead time less than demand lead time, an MTO product delivery strategy is possible. Some common items can be produced to stock as indicated by low RDV. High RDV is not reasonable for MTS, potentially leading to ATO or MTO situation. For P/D ration larger than one, lead to be MTS, hence, MTO is impossible. At the lower left-hand corner, we can see the mix area of MTS, ATO and MTO in low RDV with P/D ratio less than one. This depend on decision making from firm environment i.e. even thought the model allows for MTO, the firm may choose MTS policy with the purpose

to increase productivity. Baveja (2000) classified MTO and MTS by RDV and average demand volume: high volume and low RDV products are MTS; low volume and high RDV products are MTO.

How about ETO? Olhager did not mention in the model clearly. In case that demand lead time extremely higher than production lead time, value of P/D ratio will very closed to zero. OPP is place in extremely upstream, where design, delivery speed and flexibility are typical order winners; the ETO strategy possible to be applied. The position of ETO might point near to the top-left of the model in Fig.1, where P/D ratio is closed to zero and RDV is high.

ELCETRICAL MOTOR MANUFACTURING STRATEGY

This section introduces Characteristics and manufacturing strategy from a production management point of view of the electronic motor company. Fig. 2 shows the different size aluminum motor, the size is determined by the height of the shaft above the floor in millimeters. The motor sizes are difference between 56-450 millimeters.

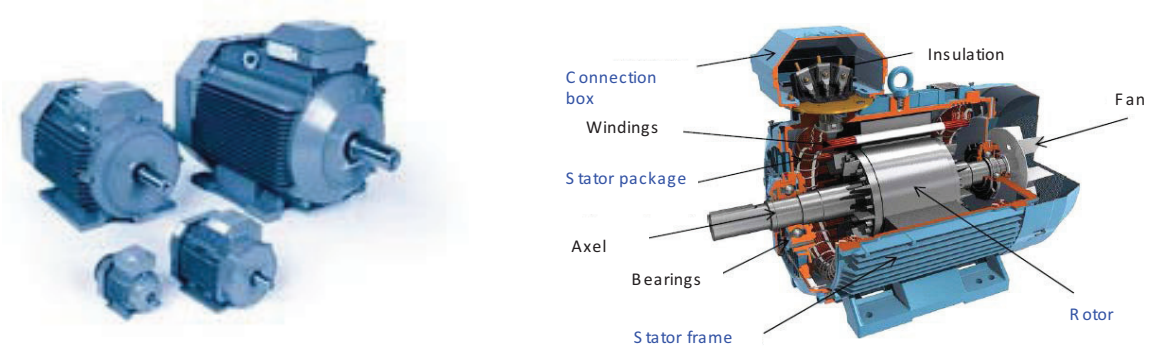

Fig. 2 Electrical motor

Main components consist of stator frame, stator package, rotor, connection box, insulation, fan, windings, axel, bearings etc. An example of an electrical motor process can be depicted as in Fig. 3.

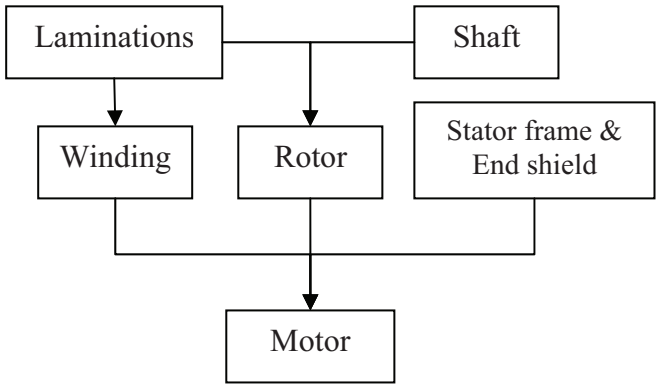

Fig. 3 An example of electrical motor process

The firm has produced around 52,000 motors per year: small, general purpose motor to big, high energy consumption motor and other specific types. It's surprise that the processing routes quite similar. Manufacturing layout depend on motor frame size and type.

The firm produces all types of customization, every quarter there will be the meeting for analyzing of demand forecast which consist of Operation, Product & Supply, and Marketing section to discuss and get conclusions for customization. For example: The products that have high demand, standardization and cheap will be Make to Stock i.e. small motor. If products have a bit longer lead time, more variety and modification, these will be Assembly to order. If products have longer lead time, then these will be Make to order. If new products need or have no Bill of material (BOM), these will be Engineering to Order. The final decision will be judged at the end of the meeting. The actual customization strategy shows in Fig. 4. Seventy five percent of production was mixed between MTO, ATO and ETO. Other twenty five percent of products were MTS (for general demand) and approximately sixty percent of these MTS products were modification before delivery. Sometime ATO was applied according to customer requirements. This shown the firm designed the process for more flexibility.

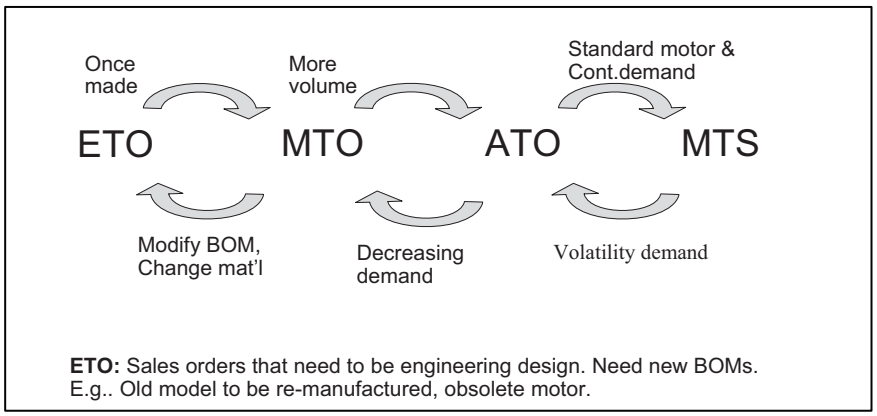

Fig. 4 Manufacturing strategy of case study firm

Engineering to order will be for new products that have no BOM. ETO will be pursued, depend on demand and competitor analysis. When demand trend to be increase, these products lead to make to order. If the demand seems to be big volume, the product will be Assembly to order. Finally, Continue demand occurred, then Make to stock. To see continue demand, firm look through the standard deviation from Variation Calculate Sheet in Direct Costing Model. Variation Calculate Sheet consists of reliability, lead time, delivery date, service level and variation of demand. History data had used for calculation. Fig.5 shows customization and cost relationship. It's quite difficult to say how difference between ATO and MTO, because these customizations lay between MTS and ETO. The meeting was discussed, where the acceptable point between customization, quick response and cost will be.

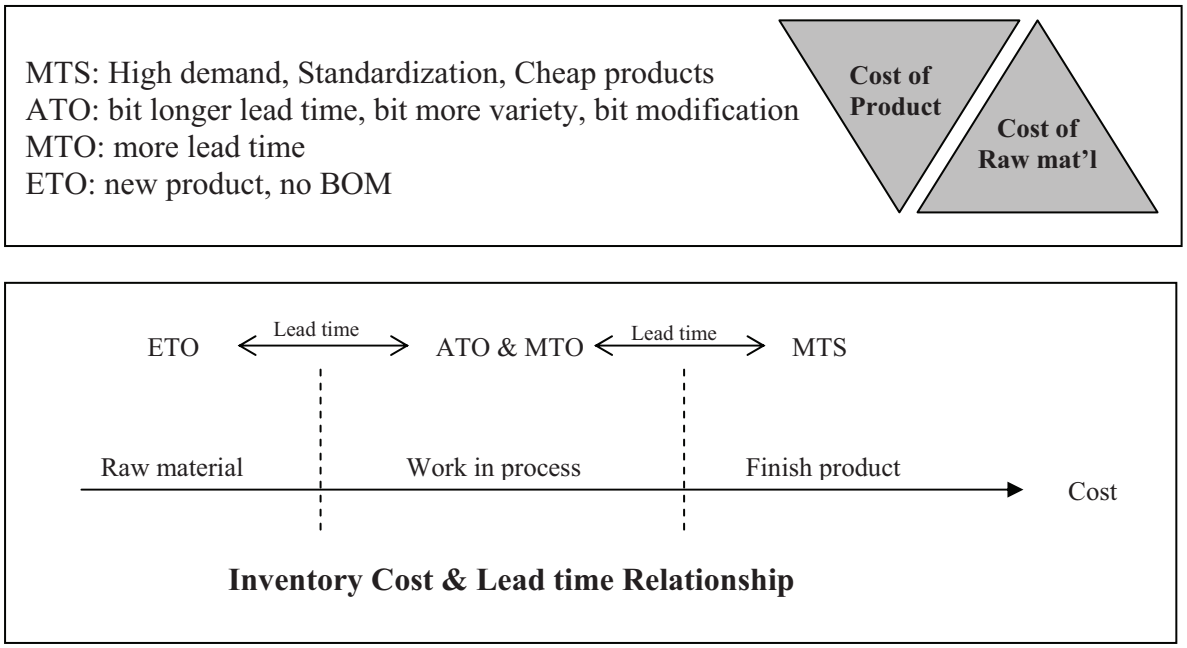

Fig. 5 Customization and cost relation ship.

Life Cycle of motor is too long, about 120 years, not too much change. Make to stock can be apply, no need to worry much about the obsolete products. Normally, the lead time will be 10-14 days. Many products have Component Commonality, stator and rotor are main components of motor. Customization of components becomes important. There are many products that have same components, may be the standard components. Big volume components can make to stock. Products classification is necessary and will be consider in product concepts or product groups, this is a top-down customized decision making as shown in Fig. 6. Parameter for classification products are frame size and pole numbers.

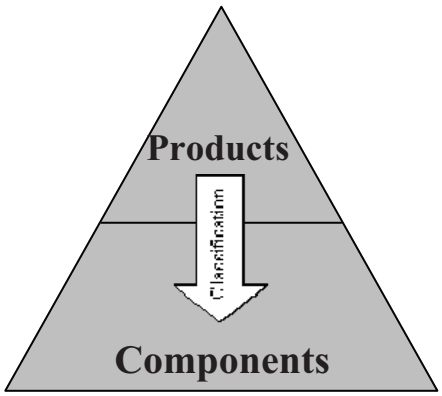

Fig. 6 Top-down customized decision

It's quite difficult to manage delivery time and manufacturing route. It's related to product structure and early variation of demand. Customer's requirement effected to variation and design of delivery. To do customize product will more difficult because of rapid change

demand. It's important to decide about Quick responses Or Customization, which is more important.

OTHER MANUFACTURING CASE STUDIES

Case of food processing industry (Van Donk, 2001)

This paper develop a framework that is an aid for balancing the factors and characteristics of market and production process that influence the decision of deciding which products to make to order and which products to stock. Using general decoupling point concept by Hoekstra & Romme (1992) and applied to the producers of Canned meat, Bakeries, chocolates, etc. Based on the characteristics of the food processing industry, factors that effect on the decoupling point (DP) are market characteristics, and process and stock characteristics.

Table 1 Market characteristics and their influence on the decoupling point *(Van Donk, 2001)*

Market characteristics	Presence/value in food	Effect on DP
Delivery reliability	High	Downstream
Delivery time	Short	Downstream
Predictability of demand	(rather) unpredictable	Upstream through information sharing
Specificity of demand	Great variety end product (with common recipes)	Upstream possibilities

In the market characteristics point of view (see Table 1), delivery times are usually short and customers need a high reliability. Both tend to have a downstream effect on the decoupling point (MTS). Short delivery times seem like unpredictable demand and retailers try to pass the uncertainty in demand to producers. In the present day, information technology can support information sharing between retailer and producer. These offer some potential for an upstream (MTO) repositioning of the decoupling point on unpredictable demand case if commonality can be used and intermediate storage between processing and packaging is technically possible. For specific demand with common recipes, effect on the upstream of DP (MTO).

Table 2 Process characteristics and their influence on the decoupling point *(Van Donk, 2001)*

Process characteristics	Presence/value in food	Effect on DP
Lead times & costs	Relevant set-up times	Downstream
Controllability	(sometimes) low	Downstream
Value added and costs of stock-holding	Unclear (in general)	--
Risk of obsolescence	High	Upstream

For the process and stock characteristics point of view (see Table 2), food processing industries have an uncontrolled process with variability that causes a down stream effect on the DP (MTS). Large cleaning time and set up time cause an downstream effect on DP (MTS). High risk of obsolescence effects to the upstream DP (MTO). In general, there are unclear pattern of value added and cost of stock-holding, thus can not position to the DP.

Case of some production to stock and semi-finished products in silos. (Van Donk, 2001)

The storage spaces of semi-finished product in silos are limit and this observed on a number of semi-finished products is used in one finished product, only. Products that have a relatively large aggregate demand will be produced in large batches and stored in silos. This shown ATO (assembly to order) was applied. For irregular demand, if the amount asked for is smaller than the minimum batch sizes, MTS will be applied. The ordered irregularly products but larger amounts than the minimum batch size, these will be produced to order (MTO)
Results from applying DP, this factory has seventy five percent of MTO product. This mean the shorter lead time occurred. Dependability and speed were improved. Stocked problems had solved to be better, effect to inventory control and shelf lives of products. The number of obsolete products is reduced as well as the inventory costs and company gain knowledge and useful information from applying DP.

Case of an automatic pencil manufacturing. (Xuan-Guo Xu., 2007.)

This paper offers conceptual model based on production process and take some certain automatic pencil as example to verify the model. Time is a key factor that influences mass customization and product flow model is based on transform process and then change into a process model based on time. Customer order decoupling point (CODP) can be positioned in certain point between MTO and MTS. Position between MTO and MTS can be defined as ATO. This study position CODP by considers processing time. It's better for all parts of one product be finished at the same time, which can avoid waiting or stock increasing. By avoiding in any transforming process, the CODP can be positioned as finished product, packing, assembling, mould design and manufacturing process.

Case of concrete cutting tools and injection molding firm. (Rajagopalan S., 2002.)

This paper develop a nonlinear, integer programming formulation for the decision about which items to make to stock and which ones to make to order, and the inventory and production policy for the make to stock items. The heuristic procedure applied to solve the problem for optimality. The objective is to minimize inventory costs of MTS items while ensuring that orders for MTO items are fulfilled within a lead time.
The study found that the average number of setups of an item selected for MTS production is always less than half average number of setups of the item if it were to be MTO. The firm realized that MTO strategy might be lower cost but has higher variability. The optimized solution is to produce the lowest and highest demand items to MTO and the rest are MTS. Items with higher per-unit holding costs (while keep all other factor constants) are more likely to be MTO. Items with higher setup times are more likely to MTS. Units processing time do not make a significant difference in MTO/MTS decision for low-demand items. When demand is large, items with high unit processing times are more likely to be MTO.
A major factor effect to MTO is lead time demand and to MTS is quick response time. This could make the demand for MTO items as function of the lead time. Others factors or production environments that have impact the decision are multiple items, changeover of items demand, setup time between the production of consecutive items, processing time, limited capacity, unit holding cost, and congestion effects. The model shows that MTO can reduce inventory costs while may be more setups, higher capacity utilization, and higher variability in order processing time. MTS might increase the lot size and inventory costs and

demand for an item might be higher if it is made to order because of the potential for customization.

IDEA OF INVENTORY HOLDING COST MODEL

However, one of the largest cost elements is also the one that is perhaps least well accounted for and that is inventory. Is it probably the case that many managers are unaware of what the true cost of holding inventory actually is? If all the costs that arise as a result of holding inventory are fully accounted for, then the real holding cost of inventory is probably in the region of 25% per annum of the book value of the inventory (Christopher, 2005). Others roughly estimations of holding cost from i-Inventory Management Review (2005) was typically estimated to cost approximately 15-35% of the material's actual value per year. Hence, companies usually estimate the inventory holding cost from the value of inventory per year that might because of the difficulty for calculating the actual holding cost. If consider with customization, we may get the holding cost that closer to the actual.

Consider with customization strategy, the companies who do MTS always stock much of raw materials and products in the warehouses wait for customer's order. As long as keeping in stocks, the holding cost of both raw material and products are increasing. For MTO, after getting customer's order, company can start order raw materials and productions, then can delivery product directly to customer. These trend to reduce inventory level, company no need to stock the unneeded materials and products before received the order. In case of ATO, company stocks some sub-assembly parts while waiting for the order. After getting order, remain raw materials were purchased, start production and delivery finished product to customers. ETO start from design process, company might have pilot process (materials for pilot model and testing) before start production and delivery. From this study, we realize that the decision for choosing which type of manufacturing pattern might affect to inventory level and holding cost. Each manufacturing type may have different inventory holding cost, depend on value and stock periods of raw materials and products. This idea shows in Fig. 7.

Inventory Holding Cost Model

Example (Material value in Mat'l cost :Euro) 300.00 day/year*

30 % Percent of material value per year [15-35%]
7,000.00 euro Material value per year (Euro, stock area, unit)
2,100.00 euro Firm Holding cost per year = Material value per year

Customize factor for Demand Stdev.

0.5 Safety Stock for ETO (%) **ETO = 1**
1 Safety Stock for MTO (%) **MTO = 2**
3 Safety Stock for ATO (%) **ATO = 3**
5 Safety Stock for MTS (%) **MTS = 4**

CS SS

Item	Production Plan (Demand) (units/year)	(units/day)	Cost (Euro/year)	(Euro/day)	Cost ratio	Holding cost 1 (Euro/year)	Supply Lead time (days)	customization	Cycle stock (units/day)	Safety Stock (units/day)	SS ratio (%)	Holding Cost 2 (Euro/year)
A	1,000.00	3.33	2,000.00	6.67	0.286	**600.00**	3	**1**	10.00	10.05	0.066	**139.35**
B	2,000.00	6.67	2,000.00	6.67	0.286	**600.00**	3	**2**	20.00	20.20	0.133	**280.09**
C	3,000.00	10.00	1,200.00	4.00	0.171	**360.00**	3	**2**	30.00	30.30	0.200	**420.14**
D	9,000.00	30.00	1,800.00	6.00	0.257	**540.00**	3	**2**	90.00	90.90	0.600	**1,260.42**
TOTAL	15,000.00		7,000.00	23.33	1	2,100.00			150.00	151.45	1.00	2,100.00

Fig. 7 Idea of inventory holding cost model

In the column of holding cost 1, there are the holding costs that have been used from many companies by reference from the percentage of material value per year. Our idea is to split total inventory holding cost per year into each components or products by using cost ratio.

The cost ratio is the ratio of each component or product value per total material value per year. Then, the holding cost 1 is equal to cost ratio multiply by holding cost per year. (The holding cost per year was estimated by 30% of total material value per year.)

In the last column, holding cost 2, we applied the similar idea with considering customization. We add safety stock ratio (SS ratio) to the calculation. Safety stock may relate to customization type (customize factor) for each components or products. This relationship seem to be more complicate and need to be analyzed with other factors for getting the reasonable customize weight factor that we will propose in later study. The researchers hope that, we can get the suitable holding cost calculation for each component and product from this idea.

TOOLS FOR DECISION MAKING OF CUSTOMIZATION

Van Donk (2001) performed the analysis from the point of view of a producer based on factors and characteristics of market and production process. Van Donk showed main factor effect to food process. Van Donk and our case study present similar analysis method, some factors were different. Similar direction with Xuan-Guo Xu. (2007) that offers a conceptual model based on production process. Xu shown deeply to the pencil process by consider time as key factor. He present which process can be the decoupling point, Van Donk did not. These conceptual models depend on difference industry and firm point of view, main factors that effect to decision making on manufacturing strategy can be different. Person who has responsibility to make decision will affect to different solutions. Many models are qualitative, many researches perform quantitative model. For example, Zaerpour N., Rabbani M., and Tavakkoli-Moghaddam R. (2008) applied mix qualitative and quantitative to these problems. They applied a novel fuzzy AHP-SWOT methodology partitioning of MTO and MTS products through the food processing company. Van Donk, Soman and Gaalman (2005) presented MS Access/ Excel tool applied to various theoretical concepts like ABC analysis and CODP. This is relatively easy to use for managers to be helpful in their decision-making.

There are many tools for solving these kind of problems. Mathematics procedure then can be applied. Rajagopalan S. (2002) used heuristic to solve this problem. He compared difference solutions in term of utilization, average queue, queue time, cycle stock, safety stock and total cost. These were the simulated results by develop a nonlinear, integer programming formulation of the problem. Analysis base on factors and characteristics of manufacturing process seem to be the primary way when we have time limitation. In reality, there are many products and components to be consider. The conceptual model may quite complicate for person who make decision, there might be some tool make these more effective. Mathematics procedure can give quantitative simulation results but need deeply theoretical knowledge and time required.

We found that there are some data relationships i.e. many products have common components, these common components produce in high volume, thus MTS can be possible. For some customers, product specification and volume might have positive relationship. Some products volume relate to time period and customer's trend. The hidden relationships among various data from company's data warehousing need to be discovered. To get better problem solving, Data mining (DM) might be one tool for these. Data mining is the process of finding useful information or patterns from large databases (Roiger and Geatz, 2003). The

objective of data mining is to discovered trend or patterns to help explanation of current behavior or to predict future outcomes. DM options are classification, estimation, prediction, clustering and market basket analysis. Data mining has been applied to many research areas: banking, credit scoring, fraud detection, customer segmentation, science, medicine and health, manufacturing etc. For example, the credit card company would like to fine a best attributes set of current customers who have taken advantage of the special promotion from those who have not. This company can pay attention to the target group that has more possibility to accept their new promotion. This clustering technique is very useful to group the data instance based on a similarity scheme. Also, market basket analysis can be applied to find interesting relationships among retail products.

In manufacturing area there are many researches that applied DM. Hsu,C.H. (2008) applied DM to develop effective mechanism to find the industrial standards that are the most suitable to apparel production. Afify et. al. (2007) used DM as a tool for detecting cyclical disturbances in steel supply networks. Chien, Wang and Cheng. (2007). Discovered the possible causes of faults and manufacturing process variation by develop a framework for data mining and knowledge discovery from database that consists of a Kruskal-Wallis test, K-Means clustering and the Variance reduction splitting criterion to investigate the huge amount of semiconductor manufacturing data .Urtubia et. al. (2007) identify early signs of undesirable fermentation behavior and unable to take possible mitigating action by DM approach. Statistics procedure always combines with Data mining. There are many popular programs that have some option of data mining i.e. SPSS, SAS, Intelligent miner etc. From those researches, we can see how useful of DM, DM might be another good tool for customization decision making that should be applied in further research.

CONCLUSION

From our case study of electrical motor company in their customization manufacturing strategy, we found that firm quite difficult to make decision of which products or components should be make to stock, assemble to order, make to order or engineering to stock. Firm consider main factors for decision making of manufacturing strategy, these factors are demand, lead time, cost, product characteristic and bill of material. We conclude several factors from our study and other researches that effect to firm's judgments in Table 3.

Table 3 present possible manufacturing strategy that can be applied when firm face with these situations. In some cases, the judgments can be difference. Depend on firm's environments and management point of views. For example, Williams (1984) noted that lower volume demand should be MTO and higher volume demand items are MTS is not always valid. Some items might order based on ascending demand and the decision. While, Rajagopalan S. (2002) found that the optimized solution is to produce the lowest and highest demand items to MTO and the rest are MTS. However, firm wanted to ensure a quick response to the customer, thus we can see combination of MTS and MTO strategy in many firms.

Table 3 Factors affect customization decision making

Factors	Parameters	Characteristic	Customization
Market-related factors	Delivery time/ Lead time	short	MTS
		long	ATO/MTO
	Product Volume	high	MTS/MTO
	Demand	unpredictable	MTO
	Demand	irregular	MTS/MTO
	Demand	specific	MTO
		variety	ATO
	Seasonal demand	yes	-
	Item Cost	high	MTO
		cheap	MTS
	Customer reliability need	high	MTS
	Customer specification	broad range	ATO/MTO
Product-related factors	Obsolescence	high risk	MTO
	Product	standardize	MTS
	BOM	no	ETO
	Design	special	ETO
		more	
	Quality	important	MTO
	Product structure	few	MTO
	Modularity	have	ATO
	Holding & backorder cost	high	MTO
		low	MTS
Firm and process-related factors			
	Process	uncontrolled	MTS
	Set up time	large	MTS
		short	MTO
	Flexibility process & human	have	MTO
	Just in time	need	MTO
	Return of investment	high	MTO
	Customer commitment	long term	MTO
	Supplier commitment	long term	MTO
	Systematic database	have	MTO
	Shop floor	simple	MTO
	Rewards skill	have	MTO
	Customer feedback	have	MTO

Mass customization is the manufacturing strategy that considers optimizing cost/resource/time constraints. In fluctuated situation, firm need to reconsider about "How to make decisions which product/component suitable for MTS, ATO, MTO or ETO. When time is limit, sometime, the quantitative procedure can not be possible. That's the reason why experience and management's vision are important and suitable tools are needed. We can see that many case studies were applied in food processing company or firms that the process is not too complex. It's very interesting to have future research to apply in more complicate processing company. More variety of products and components, we need more data warehousing and excellence tools for analyzing. Qualitative and quantitative method need to be combined. We found that Data mining is an excellence tool to cope with huge data and has strong possibility for this kind of decision making.

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FERN'S DECISION MAKING: A CHAOTIC PERSPECTIVE

Safawi Abdul Rahman
Faculty of Information Management, MARA University of Technology, Malaysia
safawi@salam.uitm.edu.my

Khalid Abd. Wahid
MARA University of Technology, Malaysia
awkhalid@kelantan.uitm.edu.my

Mohamad Shanudin Zakaria[2]
Faculty of Information Science and Technology, National University of Malaysia, Malaysia
msz@ftsm.ukm.my

ABSTRACT

This paper explores and presents the chaotic perspective with regard to decision making in identification and classification of ferns. The paper begins with a brief discussion on the chaos theory that includes its common essential characteristics followed by a brief discussion about the applicability of the chaos theory into other academic disciplines. This paper highlights the relationship between the chaos theory and psychology and decision making. The Sundlof (2005) and McKenna & Martin-Smith models of chaos theory and decision making is presented prior to discussion of our case study, i.e. the nature of fern's identification and classification and its relation with chaos theory. This is aimed at supporting our argument that the chaotic phenomena do relate to all situations in our daily life regardless the level of its complexity.

KEYWORDS: Ferns, Fern's Identification and Classification, Decision Making, Chaos

INTRODUCTION

Chaos theory explains that chaotic phenomenon that originated from a small change in the initial conditions change the long-term behavior of a system drastically (Banks et al, 1999; Lai & Grebogi, 1996; Rae, 2004). The behavior of two occurrences or systems may end up in significantly different circumstances; though depart from a very similar condition at beginning. This is due to a variety of reasons, controllable ad uncontrollable. As Mäkikallio (1998) put, a very tiny difference in the initial conditions will later result in large differences in behavior.

With regard to decision making, the intelligence, the design and the choice stages posses this chaotic phenomenon in its nature. The intelligence that commonly deal with understanding the nature of problem at hand, the design that deal with exploration of all possible justification and the choice that deal with selection of a plausible explanation (Taylor & Reynolds, 2003), are made based on observation of a range of possible characteristics that are attributed by "identical and complex" in their relationships.

The discourse of the "identical and complex" relationship of problem's characteristics may be referred and tied up to chaos. The features of two genuses of fern, for example Belsivia Mucronata and Belsivia Revoluta under family Polypodiaceae, significantly represent this identical and complex relationship. They share very identical and complex features in many classification schemes such as Rhizome and Stipe, but eventually they end up classified with different names for its classification.

In this light, the identical and complex behavior of an occurrence or system, as found in pure discourse of chaos as in Physics and aerodynamics, may be thought as the identical features of fern. Though these features are very identical in many schemes, they exhibit very tiny differences that eventually make them identified and classified differently. In functional area as in botanical, a botanist i.e. decision maker (DM) needs to properly distinguishing all these identical and complex features in order to the classifying and identifying the fern's genus and species. This is a major reason why this paper believes that this functional task involves a chaotic phenomenon in it essence.

The aim of this paper is to bring up to surface the issue of chaos in human life with aim to support the notion that chaos does penetrate many aspects of human activities including decision making. The rest of this paper goes as following. Next section presents the fundamental of chaos theory and its essential characteristics. The following section discusses the chaos theory and its application into social, psychological and decision making as found in the literature, to show that decision making possess the characteristics of chaos, followed by discussion on the models that incorporate the chaos into decision making. Next following section presents the case of fern's identification and classification by primarily taking into account the characteristic of complexity of chaos.

CHAOTIC SYSTEM: A BRIEF LOOK ON ITS THEORY AND CHARACTERISTICS

Chaos theory is a study of complex, nonlinear, dynamic systems (Levy, 1994; Cartwright, 1991) and basically based on the qualitative study of unstable aperiodic behavior in deterministic nonlinear dynamical systems (Kellert, 1993). The idea of chaos or chaotic system had been shown by Jacques Hadamard (see Hadamard, 1898) on dynamical system and Henri Poincare (see Poincare, 1903) in his study on restricted three body problem. The chaotic idea is derived from Poincare's renowned statement "it may happen that small differences in the initial conditions produce very great ones in the final phenomena".

Chaotic theory is initially concerned with and applied into physics and its sub disciplines. Examples are the works of Poincare (1892-1899) and Birkhoff (1927) on three-body problem, Kolmogorov (1941) on turbulence and astronomical problems, and Cartwright & Littlewood (1951) on radio signal engineering).

A chaotic system, as described by many researchers (Liu, 1999; Nagashima & Baba, 1999; Williams, 1997; Mäkikallio, 1998; Leiber, 1998) is attributed by several characteristics that make it uniquely identified. These characteristics will determine a system to be a chaotic or not. According to the literature that this paper analyzed, the main characteristics of a chaotic system may be listed as:

1) Sensitive dependence on initial condition

2) Determinism

3) Nonlinearity

4) Aperiodicity, and

5) Dynamic.

There are other characteristics associated to chaotic system such as constrained and definitive form (Ruelle, 1979; Grassberger & Procaccia, 1984; Procaccia, 1988), iterations (Leiber, 1998; Watts, 1996), bifurcation (Earle-Warfel Krippner, & Perakakis, 2006; Lorenz, 1993), ergodicity (Banks et al, 1992; Leiber, 1998). This paper excludes these characteristics due to that the five listed former includes all the latter. For example, the characteristic of "constrained and definitive form" of the latter has been elaborated through the "determinism" criterion of the former.

Therefore, the discussion is centered around these five, due to that they are attended very well by scholars when discussed about chaos. Since this paper concerns with chaotic phenomena in psychology and decision making, the technical part of chaos as widely found in mechanics and physics, would be avoided. As a result, the discussion on characteristics of chaos would be narrowed down to only accomplish the need of social science and psychological perspectives.

Sensitive Dependence on Initial Condition

One of the main characteristic of chaos is sensitive dependence on initial condition (Ruelle, 1979; Gleick, 1987; Crutchfield et al. 1987; Lorenz, 1993; Schittenkopf & Deco, 1997; Leiber, 1998; Makikallio, 1998; Nagashima and Baba, 1999; Liu, 1999). For this characteristic, chaos is observed from the very small differences in the initial conditions in a system that will later result in large differences in its behavior or events. It starts with a same state at initial point, moves across the time, spreads (freely), and ends up diversely. There is a possibility that a very small occurrence capable to produce an unpredictable results by triggering a series of increasingly significant events. In the work of Lorenz (1963) this is known as butterfly affect.

This important characteristic of a chaotic system, found significantly at features of ferns. Many features under Rhizome and Stipes schemes exhibit this characteristic as excerpted in Table 1. Therefore, this characteristic is strongly explained the chaotic issue in fern's identification and classification.

Determinism

Lorenz (1993), Liu (1999), Grassberger & Procaccia (1984) Procaccia (1988) and Mäkikallio (1998) characterize chaos with deterministic rule. By definition, a deterministic system is a system in which later state evolves from earlier ones according to a fixed law (Lorenz, 1993; Dawoody, 2004). Each current value (or state) of the system determines the next value exactly which suggest that the initial (starting) value determines the behavior at all future times (Caraco, 2004). Thus, this sort of chaos is to follow a high degree of order. Although the system may appear and look random, in reality the behavior is bounded, and the deterministic laws it follows are decisive enough which means that the system's states of past, present and future are controlled by deterministic rules (Liu, 1999).

This paper argues that the fern's classification and identification also characterized by deterministic rule. This is due to that the characteristics of ferns are bounded to certain limits though their behaviors and patterns are varied. More importantly, despite the identical and complexity order of these behaviors and patterns of fern's features, they are deterministic according to a fix law of identification.

Nonlinearity

Most of chaotic system is of nonlinearity (Liu, 1999; William, 1997). Nonlinearity of chaos system means the non-superposition of factors or effects (Liu, 1999). In another word, chaotic systems can become truly random (Ford, 1983) and that output is not directly proportional to input or that a change in one variable does not produce a proportional change or reaction in related to variable(s) (William, 1997). Deterministic relationship of nonlinearity could produce patterned yet unpredictable outcomes (Levy, 1994).

This paper argues that fern's features display this characteristic as well. The ferns differ in their size, color, height and healthy although they grow in the same locality, and let alone the ferns that grow in different locality or region. Definitely they grow in non linear patterns of these attributes due to differences in the water stream and supply, soil, weather, density and other environmental effects.

Aperiodicity

Aperiodicity is another special character for chaotic system (Leiber, 1998; Schittenkopf & Deco, 1997; Liu, 1999; Gleick 1987, Procaccia 1988; Mäkikallio, 1998). Chaotic motion will definitely create a new topological type of motion that is very different from fixed point, limit cycle and limit torus, and its orbits are non-periodic (Liu, 1999). There are no identifiable cycles that recur at regular intervals (Makikallio, 1998) which mean that a chaos orbit can never join another one or repeat its path's history. A dense aperiodic points created along its path will never recur again.

Even though this is another important characteristic of a chaos system, this paper excludes it from characteristic of ferns for classification and decision making purpose. This characteristic matches the motion of orbits, fractal and geometry and very less related to the characteristics of ferns.

Dynamic

Another characteristic of a chaotic system is dynamic (William, 1997; Marion, 1999; Stacey, 2000; Leiber, 1998; Leiber, 1997; Schittenkopf, C. & Deco G. 1997). According to William (1997), a dynamical system is anything that moves, changes or evolves in time. It is the one that constantly learns and changes in response to environmental forces, changes human networks and changing concepts (McBride, 2005) and has no permanent state. There would be a proverbial leap into the unknown state due to the rich potential for new effects and outcomes. Chia (1998) describes a dynamic is an inherent fluidity situations. He sees human systems are 'by nature fluid, transient and perpetually changing'; organizations may be described as 'perpetually changing configurations of relations which are continuously transforming themselves'.

This paper strongly believes that fern's behaviors obviously display this characteristic. As mentioned earlier, the fern's size, height, color and other features of a species in the same locality are varied according to the soil, water supply, density and other environmental effects. Since the growth and the characters of ferns are dynamic, classification and decision making process on fern's species and genus would be a challenging task.

Despite there are five major characteristics of chaos discussed, this paper considers only four (4) appropriate characteristics to be incorporated into case study on fern's classification and decision making. Those characteristics are sensitive dependence on initial condition, deterministic, nonlinearity and dynamic. It is strongly believe that these four are the essential characteristics and satisfactorily representing the chaotic behavior of fern's species and fern's decision making.

EXTENSION OF CHAOS THEORY INTO OTHER DISCIPLINE OF STUDIES

The study of chaos has been extended into other areas and is not solely limited to physical science study. Currently, the theory and application of chaos theory have been extended into a variety of academic fields of studies such as ecology (Kauffman, l99l), medicine (Goldberger, Rigney & West, 1990) international relations (Mayer-Kress and Grossman, 1989), economics and social science (Baumol and Benhabib, 1989; Kelsey, 1988), education (Reigeluth, 2004) and psychology (Krippner, 1994; Barton, 1994; Remer, 1999a; Remer, 1999b; McKenna & Martin-Smith, 2005). The work of Lorenz (1963) and Li & Yorke (1975) have widely been recognized as the impetus for the development of chaos theory in these new decades.

In discussing the relation of chaos theory with other academic disciplines, Hassard and Parker (1993) utters a remarkable point that "the proponents of chaos theory enthusiastically see signs of it everywhere, pointing to the ubiquity of complex, dynamic systems in the social world events, and the resemblance between patterns generated by simulated nonlinear systems, for examples in stock exchange or commodity prices". They further added that from a theoretical perspective, chaos theory is congruous with the postmodern paradigm, which questions deterministic positivism as it acknowledges the complexity and diversity of experience.

The nature of chaos implies an absence of organization, a disorder in which uncertainty and unpredictability predominate. Therefore, recent applications of chaos theory and complexity theory have been incorporated into organizational and management studies (Mitroff & Linstone, 1993). Due to its profound influence on many areas of social science and humanities, it importance and inline with organizational behavior and needs, chaos theory is recently acknowledged by organizational theorist (Hassard and Parker, 1993). Radzicki (1990) and Butler (1990) amongst others have noted that social, ecological, and economic systems also tend to be characterized by chaotic behavior i.e nonlinear relationships and complex interactions that evolve dynamically over time. Recent applications of chaos theory and complexity theory in organizational and management studies further enhance understanding both the world as an integrated whole (Mitroff and Linstone, 1993), and the decision-making tool kit (McKenna & Martin-Smith, 2005).

APPLICATION OF CHAOS THEORY IN PSYCHOLOGY AND DECISION MAKING

The application of chaos theory into psychology study has been clearly noted by Barton (Barton, 1994). While discussing the causality reasoning in human psychology, one spread commonsense notion is that a slight difference in an antecedent condition should lead to only a minor difference in that condition's effect (Mandel, 1995). Barton argues this commonsense notion by introducing the concept of sensitive dependence - a characteristic of a chaotic behavior – which confronts the prior notion. As to Barton, "their specific solutions will diverge dramatically from one another over the long range" which implies that the small differences would eventually lead to a large affect and those specific behaviors of sensitively dependent systems will be unpredictable over the long range.

Human behavior and his cognitive ability display a dynamic, nonlinear and complex attributes. The application of chaos theory into human behavior deserves attention due to the affinity of both areas (Krippner, 1994). Barton's (1994) statement on causality reasoning and Krippner's (1994) statement on human behavior imply that chaos theory has a significant correlation to humanistic psychology. Decision making, as a sub part of discipline of humanistic psychology would be inline with this notion. As a human, each individual is

capable of making choice. Because of this, chaos theory is seen to be limited, but still valid in dealing with aspects of social systems and human behavior (McKenna & Martin-Smith, 2005).

The process of decision making is opened up to a host of dynamic linkages, so that isolated traces of single decisions come to be seen as interwoven networks of issues (Langley et. al, 1995). From this perspective, chaos and complexity are a strong challenge for decision maker. A decision maker should be able to identify the right link from a number of dynamic relationships between alternatives and options, so that a proper decision could be made. From another perspective, chaos and complexity theories offer insights that can be powerful tools for decision makers (McKenna & Martin-Smith, 2005). In enabling an appropriate decision, a decision maker needs to comply with chaos and complexity, as tools to help him reach a decision. Reduction of chaos and complexity would mean the increase of better potential solution to a problem.

CHAOTIC PERSPECTIVE IN DECISION MAKING: THE MODELS

In his study on weather forecasting, Lorenz (1963) found that a very small difference at initial state of a system may produce a big difference on later state, as time and variables progress. In Lorenz's term, this situation is known as butterfly effect. Diagram 1 depicted the Lorenz's butterfly effect diagram based on his weather's sample data and experiment. At initial state of the signal, there is only a single signal line. At one point as time progresses and the data is varied, a bifurcation occurs which produces two signal lines. The two lines move randomly onward, producing their own non-linear, dynamic, unpredictable path. This basic diagram serves as a starting point for understanding of chaotic phenomena.

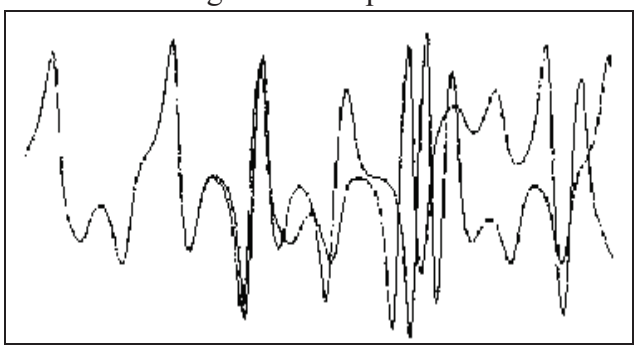

Diagram 1: Lorenz Experiment – The Butterfly Effect
Adopt from Ian Stewart, Does God Play Dice, The Mathematics of Chaos, pg. 141

This paper gathered two models that integrate chaos theory and DM with aim to relate the two concepts. The models are introduced by Sundlof (2005) and McKenna and Martin-Smith (2005) respectively. Graphically, both models are representing interesting points to be considered within decision making framework.

Diagram 2 is a model representing a regulatory decision making based on chaos theory (Sundlof, 2005). This model comprises of independent variables of conflicting values and uncertainty as bottom lines. According to Sundlof (2005) the model is intended to serve as a diagnostic tool for risk managers facing difficult policy decisions. Complexity in this model is a function of two independent variables, uncertainty and conflicting societal values. As complexity increases, the ability of risk managers to make sound decisions becomes more difficult. The model is divided into three regions. In the lower left hand region where uncertainty is small and there are few conflicting values, decision making is relatively simple

and straight forward. At the opposite corner, uncertainty is relatively much great and values are in such violent conflict that all attempts at decision making are thwarted. In the center region of the model, decision making requires an understanding and weighing of multiple variables.

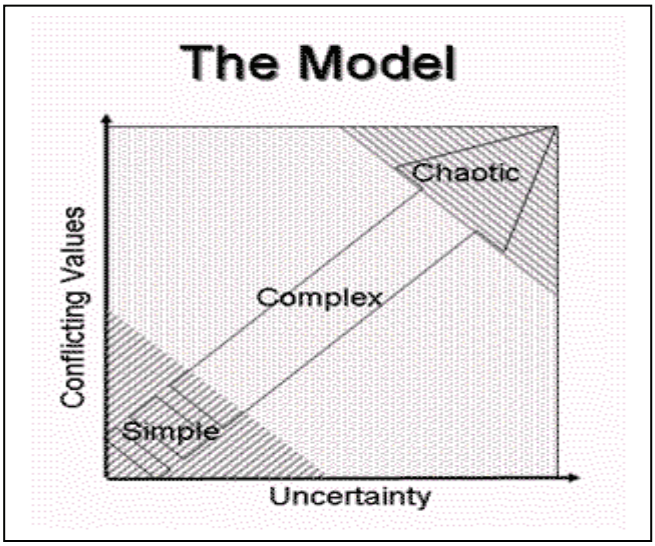

Diagram 2: Regulatory decision making model based on chaos theory
Adopt from On Science and Uncertainty: An Application of Chaos Theory, Sundlof (2005)

As seen in the model, the decision making process is considered to be simple and ordered at initial point. This is due to that, at this level, uncertainty and conflicting values are low. As time progress, the two independent variables: conflicting values and uncertainty have increased and they start to open to a complexity constraint. At this middle level, decision making process becomes more challenging due to that a decision maker needs to observe a wider perspective i.e. unpredictable relationships and other constraints. In the third level, the chaotic region, the environment is seen as fully dynamic, non-linear and unpredictable.

Diagram 3 below is an illustration to explain that classical and behavioral decision making is a dynamic cycle set in a complex and chaotic environment, and influenced by the complex interactions between human beings. Conversations, as the main symbol of human relationships, play a central role and the psychodynamics of individuals and groups are important. The decision process is expressed as both a cycle of action-discovery-choice (Stacey, 2000) and a cycle of craft-art-science (Mintzberg & Westley, 2001). Conventional decision sciences provide tools that assist primarily at the choice/science stage. New research initiatives using alternative approaches, embracing chaos and complexity and recognizing different paradigms of human and social behavior – psychodynamic and relationship psychologies – are essential to enable us to understand and explain the stages in chaos embedded cyclical processes (McKenna and Martin-Smith, 2005).

As shown in Diagram 3, this model emphasizes on conversation and its relationship to other influenced paradigms such as internal system and it agents, knowledge, beliefs, emotions and organizational matters. Through this model, a decision maker needs to follow a sort of scheme of action (craft), discovery (art) and choice (science) in making decision. By the time the decision maker is considering the action, he needs to look at external consequences from other system and agents. He also needs to take into account human psychodynamic and psychology of social relationship for communication effectiveness. Conversation and

consideration on human and social behavior would give rise to complexity and chaos in the process of making decision.

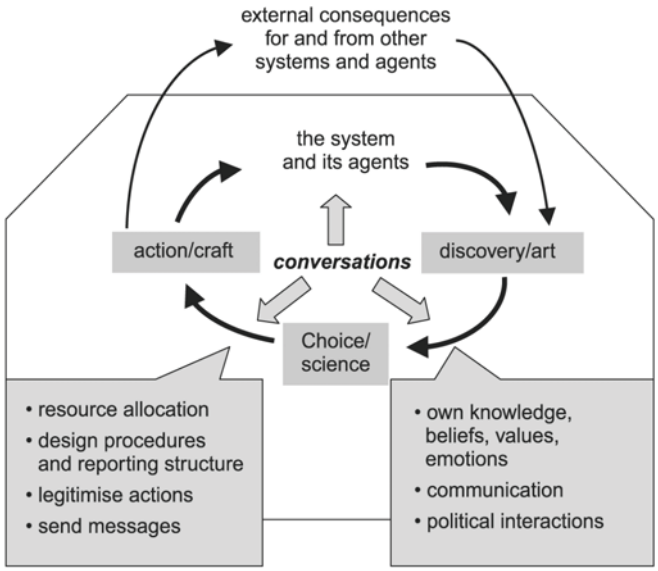

Diagram 3: A model of the chaotic dynamic cycle of the decision-making process
Adopt from Decision making as a simplification process: new conceptual perspectives, McKenna and Martin-Smith (2005)

The literature and the models discussed above signify that chaos and complexity exist in decision making application. The processes themselves are not chaotic, but the considerations the DM need considers are the forces that lead to the chaos. In the models, it is observed that 1) conflicting values, 2) uncertainties; 3) external consequences, 4) knowledge, beliefs, values, emotion, communication political interactions and 5) resources allocation, design procedures and reporting structures, legitimize action and send messages are attributes that cause the chaos. However, since these attributes are components that incorporated into process, the process appears at the surface and seen as chaotic. This manner applied in the case study presented in next section. Identification and classification, in their first place are not chaotic. However since the features of ferns match the characteristics of chaos, the processes of identification and classification seen as chaotic as well. Decision making that deals with consideration and identification of available alternatives, may be affected by chaotic paradigm such as humanistic psychology (Krippner, 1994) and social and human behaviors (Barton, 1994).

IDENTIFICATION AND CLASSIFICATION OF FERN'S GENUS AND SPECIES

Based on characteristics of a chaotic system discussed earlier, this paper again argues that the task of identifying and classifying of a fern's genus and species is of chaotic and challenging tasks. By chaotic and challenging here, the paper means the chaos in the ferns' characteristic, not in the process of identification. Table 1 below presents an excerpt of the features of fern as extracted from Holttum (1968)[1] and Holltum (1985). As shown in this table, the limitation is made on three species (variations) that belong to Belsivia genus under Polypodiaceae

[1] Extraction process is based on Holttum (1968) that contain full features of Malaya's ferns' family. We also refer to Holttum (1985) for elimination and convergence of some fern's species and families. Extraction process is supervised and examined by a botanical expert for its accuracy and validity.

family. This is done for reason the three species considered representing the entire species as they are characterized by the same characteristics.

Identification	Classification	Decision	
Sub Criteria	Main Criteria	Species	Genus
Rhizome-scales ovate	Rhizome	Revoluta	Belsivia
More or less tipped but not long pointed	Rhizome		
The middle part very dark with conspicuous large thick-walled cells	Rhizome		
The edges thin	Rhizome		
Pale brown	Rhizome		
Of much smaller cell	Rhizome		
Usually distinct	Stipes		
To about 3cm long	Stipes		
Sterile portion to about 25 by 1.2cm	Frond		
Narrowed gradually to both ends	Frond		
The veins all hidden or main lateral veins sometimes distinct	Frond		
Fertile portion widening from the very narrow apex of the sterile portion	Frond		
About 3-15cm long and hardly over 3mm wide	Frond		
Rhizome-scales of uniform color throughout	Rhizome	Mucronata	Belsivia
Dark	Rhizome		
Acuminate	Rhizome		
The cells all large and thick-walled	Rhizome		
Edges shortly toothed	Rhizome		
Short	Stipes		
To about 25 by 2cm excluding the fertile portion	Frond		
Narrowed evenly to base and apex	Frond		
Constricted at junction with fertile portion	Frond		
Veins usually faintly visible	Frond		
Fertile portion about to 3-12cm long and to 3mm wide	Frond		
Rhizome-scales of uniform color throughout	Rhizome	Callifolia	Belsivia
Dark	Rhizome		
Acuminate	Rhizome		
The cells all large and thick-walled	Rhizome		
Strongly toothed	Rhizome		
Usually short	Stipes		
Sometimes to 6cm long	Stipes		
Sterile portion 3-6cm wide and 20-40cm long	Frond		
Thin	Frond		
Narrowed gradually to the base	Frond		
Usually rather abruptly at the apex	Frond		
Not constricted at junction with fertile portion	Frond		
Veins usually faintly visible but no prominent main veins	Frond		
Fertile portion 10-30cm long and 3-5mm wide	Frond		

Table 1 : Features of Fern's Species

Classification of fern's genus should follow some predetermined schemes. Generally, for classifying fern's specimens into its species and family, the Rhizome, Scale, Stipes, Frond, Veins, Sori, Sporangia and Lamina are among the main features that need to be considered. For the case presented in this paper, the main features of Rhizome, Stipes and Frond are involved. These three features produce a list of sub-features as shown in Table 1 on next page.

For example, the main feature of Rhizome is characterized by a set of sub-features: rhizome-scales ovate, more or less tipped but not long pointed, the middle part very dark with conspicuous large thick-walled cells, the edges thin, pale brown and of much smaller cell.

The main feature of Stipes is characterized by only two sub features of usually distinct and to about 3cm long. The sub-features of sterile portion to about 2.5 by 1.2cm long, narrowed gradually to both ends, the veins all hidden or main lateral veins sometimes distinct, fertile portion widening from the very narrow apex of the sterile portion and about 3-15cm long and hardly over 3mm wide are character of Frond. These sub and main features are indicators for the classification decision that the species is Revoluta, a species within Belsivia genus.

DISCUSSION

The data in Table 1 is represented into a graphical representation as below. Note that this section confines the species to include only Mucronata and Callifolia, instead of three species shown in Table 1. The confinement is made with believe that the two species are representing the rest and to ease the mapping process which then would help in understanding. In this example, the signs of non-linearity, deterministic and dynamic characteristics that build the complexity and chaos could be obviously seen. Our aim is to show that fern's classification and identification are of chaotic task.

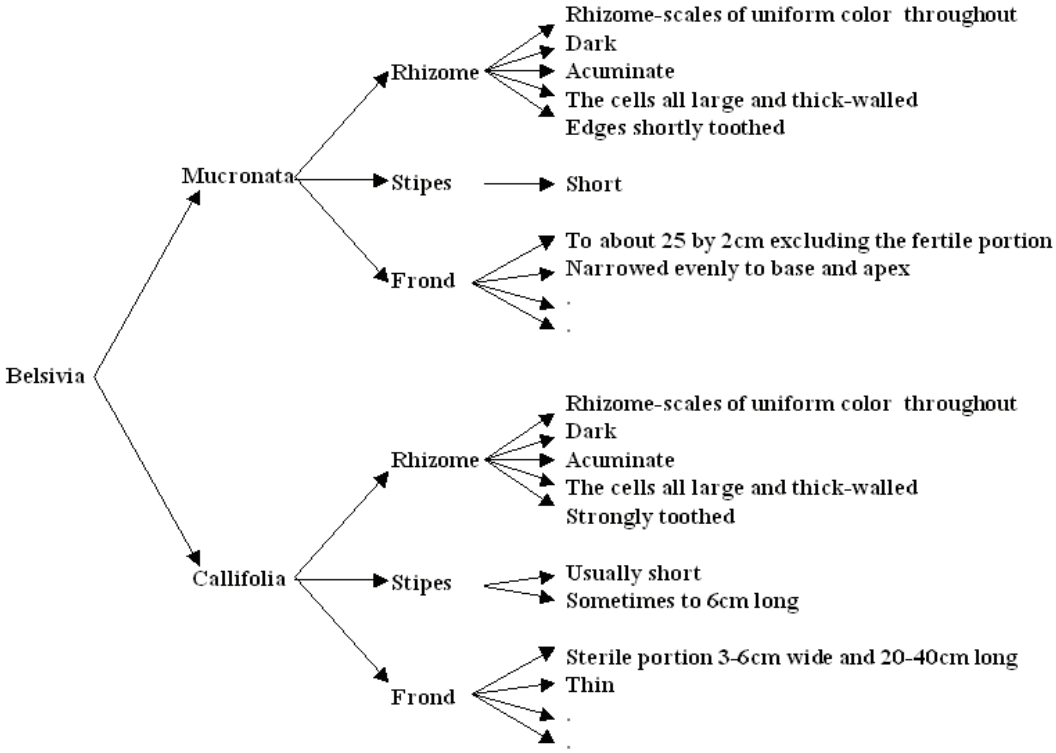

Diagram 4: Decision Tree for Belsivia Family

As depicted by the diagram, identification process would be by observation on main features of Rhizome, Stipes and Frond. The rhizome is characterized by the following properties: "rhizome-scales of uniform color throughout", "dark", "acuminate", "the cells all large and thick-walled" and "edges shortly toothed". As for Stipes, its character is "short". The Frond is characterized by the following: "to about 25 by 2cm excluding the fertile portion", "narrowed evenly to base and apex", "constricted at junction with fertile portion", "veins usually faintly visible" and "fertile portion about to 3-12cm long and to 3mm wide". Deliberation on these features will lead to a decision that the fern's species is Mucronata.

The same characteristics as belong to Mucronata are shared by another species. As for Rhizome, the characteristics of "rhizome-scales of uniform color throughout", "dark",

"acuminate", "the cells all large and thick-walled" are remained, but the characteristic of "edges shortly toothed" is now slightly change to "strongly toothed". For Stipes, the characteristic of "short" for Mucronata is now developed into two characteristics that are "usually short" and "sometimes to 6cm long". The frond of this species is characterized by "sterile portion 3-6cm wide and 20-40cm long", "thin", narrowed gradually to the base", "usually rather abruptly at the apex", "not constricted at junction with fertile portion", "veins usually faintly visible but no prominent main veins" and "fertile portion 10-30cm long and 3-5mm wide". All these characteristics are slightly differ as to characteristics of Frond for Mucronata. The deliberate observation on these characteristics would enable a decision maker to reach into conclusion that the species is Callifolia.

From the given case, characteristics of chaotic system and/or behavior are obviously seen. Most of the main and sub features of Mucronata and Callifolia presented in this example are identical at the beginning point. However, they grow in a different way in some dimensions to to be identified as different species. Though the two species originating from a one starting point, a very tiny difference of "edges shortly toothed" and "strongly toothed" on Rhizome, "short" and "usually short", "sometimes to 6cm long" on Stipes would lead decision maker to a different conclusion.

These characteristics are of deterministic values and would be an important point for decision making i.e. the first is Mucronata and the second is Callifolia. In this example, deterministic may means that a fern's specimen featured by these characteristics fall into variations of Belsivia genus. It could be either Mucronata or Callifolia species, not other species outside of this genus. Perhaps some of the characteristics possessed by Mucronata and Callifolia are also characteristics for other species and genus. If that is the case, it happens to be by chance because some ferns of different genus are characterized by identical attributes.

The non-linearity character is traced from the specimen's features as mentioned above. Most of these features considered to be the same but there are also distinction and addition at several features that differentiate its class and species. For example, identification of Mucronata is based on single "short" feature of Stipes. But, identification of Callifolia is based on two features that are "usually short" and "sometimes to 6cm long" on its Stipes. This means that non-linearity exists on Stipes, where the count of sub-features is not linear and uncertain. It sometimes could be short counts and generally prescribed, and at another time it could be long counts and specifically prescribed.

The dynamic character of the fern's species is inline with non-linearity as it is uncertain and subjected to changes according to certain condition. Physical observation on specimen's properties such state, size, height and color of the Rhizome, Stipes and Frond have shown some differences. These properties are not static and they differ in accordance to the locality, soil, density of plants, water stream and supply, fertilizer and etc. that affected the live of the specimen. For example, the features of "veins usually faintly visible" and "fertile portion about to 3-12cm long and to 3mm wide" on Frond of Mucronata is different to the one on Frond of Callifolia that of "veins usually faintly visible but no prominent main veins" and "fertile portion 10-30cm long and 3mm wide".

Based on the discussion, this paper again insists that the decision making process i.e. identification and classification of fern's specimen into its species, is challenging and chaotic tasks. This is due to the existence of chaotic behavior and complex relationship on the fern's characteristics. Therefore, decision maker needs to have a thorough observation when conducting an identification and classification processes. Moreover, while doing this observation and reasoning, the decision maker's mind and cognition may be in chaotic

condition, as prescribed by humanistic psychology, as he needs to utilize his knowledge and experiences in order to recognize and differentiate the resembled features that belong to a particular species prior to reaching a conclusion.

CONCLUSION

The essential characteristics of chaos theory :- sensitive dependence on initial conditions, dynamic, deterministic and non-linearity as acknowledged in this paper, are characteristics of real world. The fields of human daily life that include ecology, medicine, international relations, economics, social science and education for examples, are inevitably featured by chaotic phenomena. Decision making as part of human daily is therefore unavoidable from this chaotic force. In one of the functional areas of decision making, i.e. fern identification and classification, the chaotic phenomenon is obviously observed. A decision maker should understand the complexity of this phenomenon and deliberately handling the task to enable the accomplishment of decision making objectives.

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WHY EUROPEAN TWO TIER BOARDS INSTEAD OF US SINGLE BOARD?

Dr. Rado Bohinc, University Of Primorska, Faculty Of Management, Slovenia
Rado.Bohinc@upr.si

ABSTRACT

In this article we try to analyze the differences and similarities, advantages and disadvantages of US single board system of corporate governance comparing it with some European two tier systems. When we use in this article the phrase:"European two tier board" we have in mind two tier systems that is in different ways introduced in some European countries legislations and which we present in this article. It is intended, that legal analyze of this issue that has been much discussed in US theory, contribute to some progress in defining best alternatives in this field of enormous importance for economic efficiency. There is no doubt that there is a direct correlation between the specific corporate governance system and the efficiency of a corporation. Which of the two systems is more efficient, remains a question that is beyond legal analyse of the problem.

I. US CORPORATE GOVERNANCE CONCEPT

US Theories on Corporate Board's Role

There are at least three important theories reflecting the issue of the role of corporate boards in US corporations :

Contra-managerial (hegemony) theory, according to which the board's most important function is to ensure the independence of the board and management to act in the best interest of shareholders. It identifies managerial influences over corporate boards, informational and personnel (in the sense of their selection to the board) dependence of the board members on

CEO and management, conformity of the board members), and suggests different legal remedies to overcome it like the majority of independent directors at the board and committees of the board, composed by independent directors .

Agency cost theory stipulates that corporations use boards to reduce agency costs There are at least the following sources of costs of contracting :

- Simple market power includes both monopoly power of a firm with respect to its customers and monopsony power with respect to a firm's suppliers
- Lock-in refers to dependent relationships that may arise between various groups that contract with a firm over a long period of time
- Long-term contracting risks refer to the well-known problem that uncertainty increases as the duration of a contract lengthens.
- Asymmetric information and strategic bargaining refer to a general problem involved in any complex economic enterprise.

- Conflicts of interest describe the inevitable costs of meeting the demands of the diverse groups of people involved in most enterprises. These costs grow larger as an enterprise increases in size and complexity.
- Alienation, a concept from social psychology, refers to the tendency of workers in modern industrial societies to feel detached from the purpose of their work and therefore unmotivated

According to this theory, in addition to monitoring, there are market methods to align the managers' and shareholders' interests (as for ex. stock ownership by managers) This theory does not accept legal intervention to modify board composition and functioning and rejects a uniform rule that makes the board predominantly independent
Same theory oppose changes in the corporate governance system that would assign control rights to stakeholders other than shareholders and disagree that individuals who explicitly represent stakeholders other than shareholders as a whole should be put on boards. According to this theory, such a system of corporate governance will lead to balkanization of the board and render it incapable of making hard decisions. Special stakeholder representatives would, by definition, have too narrow a focus on the interests of the group they represent. The long-term health of the corporation, and the long-term interest of all its constituencies, may require decisions that work to the disadvantage of one or another constituency at any given point in time.

There are other opinions as for example Gilson's who thinks that codetermination is a second institution that might warrant re-evaluation when considered from the perspective of a tradeoff between commitment and adaptability. The increasing pace of technological change likely will force workers to bear a higher level of risk with respect to their firm-specific human capital investments. In other words, competition simply may not allow subsidization of workers whose human capital has been devalued by technological change.

The informational differences between management and labor critically influence the corporate governance system's ability to facilitate the tradeoff between commitment and adaptability. Game theory literature demonstrates that the players in bargaining games with asymmetric information often fail to reach a resolution even though gains from trade are available .

Relational Theory of Boards, Power Coalition Theory is based on sociological and organizational behavior literature and it explains that coalitions, comprised of different corporate constituencies such as shareholders, creditors, and employees, interact in a political, economic, cultural, and social environment to influence corporate behavior. When the influence of a coalition on a particular matter is controlling, it is the dominant coalition and represents the corporation on that matter. Besides monitoring there are other, so called relational functions of the board, but due to the conflict of interests they must be separated into two boards: (a) monitoring, composed by independent directors resolving the issues of conflict of interests and (b) relational dealing with other board matters, possibly composed by people having business alliances with the corporation.

There are opinions who believe that the present system -- by which directors are elected by the shareholders but are empowered to exercise their fully discretionary business judgment to balance the interests of all stakeholders -- is appropriate for this time in the United States.

Effective corporate governance depends on strengthening the board of directors by having a majority of truly independent directors and by improving board practices, not on changing the laws and regulations that define the parameters of corporate governance today .

And finally we have very concrete proposals for corporate structure reform. According to Dallas the reformed corporate structure would consist of two boards, each ideally composed to perform certain functions. One board, called the conflicts board, would perform conflicts monitoring and would be composed solely of independent directors, who are outside directors with no business relationships with the corporation or its management. The other board, called the business review board, would consist of a mix of different kinds of directors and would perform other relational roles. A full-time ombudsperson, selected by independent directors, would assist the independent directors in performing conflicts monitoring on the conflicts board or existing unitary boards

The issues, broadly discussed by the theory to which we give some comparative analyze are thou related first of all to the issue of the composition of the board (single or dual) and distribution of powers between boards and the board of directors and executive management.

In addition the discussions goes on about labor and other than shareholder's constituencies in the boards in one and two-tier system.

Not very few thoughts are devoted to find solutions for more efficient supervision and monitoring of management, the issue that relates to the question of independency and outside directors, board's committees and other forms of solving the agency cost problem, as efficient as possible.

Bottom up US corporate governance reform: outside directors and committees of the US board

Since the early 80 corporate America has undergone somewhat of restructuring. Substantial changes and even more proposals referring to empowering the role of outside directors, introduction of committees as management tool and separation of board and management leadership.

Obviously the reality works much different than the statutory model presumes. According to the part of theory, public corporations are huge entities and board of directors are usually part time overseers. Modern boards of directors are composed primarily of outside directors, and clearly the board of large publicly held corporation is not able to review a number of specific matters in depth at a meeting.

Together with the understanding of the board's principal role as monitoring rather than operational there has been an increasing trend of outside directors in the boards of directors in US publicly held corporation. This trend was well supported by institutional shareholders and the market itself.

The majority of outsider boards, as a corporate standard was a view implemented in a first draft of Corporate Governance Project Principles o American Law Institute in 1982. In

addition there is a trend of supporting the idea of separation of the functions of chief executive and president of the board.

Market accepted outsiders favourably and major stock exchanges (as NYSE) require listed companies to have out side directors and corporate audit committees composed of outside directors. Even courts looked at outside composition of the board more favourably. Corporate boards of directors in publicly held corporations are becoming more and more monitoring rather than operational.

The conflict of interest between management and shareholders, derived from agency concept of the corporations' relations, has been tried to be solved through different ways of supervisory forms introduced in the framework of single board system.

The idea of outside directors was no doubtfully broadly supported by manager's and bar professional organizations. Even the American Law Institute's project (the Principles) on corporate structure, in the initial phase, included a mandatory provision that boards of public corporations consist of a "majority" of independent directors , which was in 1984 reduced to a recommendation

There is a number of empirical studies on increase of independent, outside directors in US corporations, but none on the efficiency of the corporation that have introduced independent directors. The theory begun to ask questions: Are independent directors poor at monitoring management? Is the problem that these directors are not truly independent? Would professional directors, nominated by institutional investors, be better monitors? Is the board really important as a monitoring device at all? Are there better ways to control management, such as by compensating managers with corporate stock and thus aligning their personal interests with the interests of shareholders ?

Besides the monitoring function board of directors plays other important roles important for external communications of the corporation especially if we understand its concept according to theory of coalition of power, which relates to the social responsibility of corporation. There were proposals for reform of Corporate Boards of Directors for one board in the two-board system recommended one of them to be composed solely of independent directors to handle conflicts monitoring, but never broadly accepted.

II. US SINGLE BOARD

Generally on statutory regulation of US single board

US corporate law, similarly to UK law , provides only for single board system with no mandatory labor representation. According to Revised Model Business Corporation Act, 1984 , (hereinafter referred as MBCA (1984), par. 8.01. each US corporation must have a board of directors, except as it is provided for in par. 7.32 . Exceptions refer to shareholder agreement that may dispense or limit the authority of the board of directors. In addition thus US law provides for shareholders agreement as a tool to introduce nontraditional corporate governance model (we discuss shareholder's agreement on corporate governance separately).

The powers and duties of the board of directors are defined by the following rule:

"All corporate powers shall be exercised by or under the authority of its board of directors. The business and affairs of the corporation shall be managed under the direction of its board of directors "(MBCA, par 8.0.1 (b)). The Delaware code formulate the powers and duties in a way representative of all other US state corporation statutes, saying that "…the business and affairs of every corporation must be managed by or under a direction of a board of directors, except as may be otherwise provided in the code or in its certificate of incorporation". The California Corporation Code states that the board may delegate the management of day to day operation to other person, "…provided that the business and affairs of the corporation shall be managed and all corporate powers shall be exercised under ultimate direction of the board "(Corp C par. 300 a).

We can learn from this rules that statutory model of US corporation is basically, in vesting all corporate powers to a single board of directors (unlike separation of management from supervisory board, provided for in some European legislation), with no further mandatory rules referring to composition of the board (as for ex.: mandatory participation of labor directors, as provided for in some European legislations). Board of directors is mandatory according to US legislation, unless shareholder agreement in corporations whose shares are not publicly traded, is validly concluded to eliminate the board and put all the corporate powers in the hands of shareholders, which is again a specific, not possible to find in European legislation, even for private corporations.

Powers and duties vested to the board by law can be thus exercised directly by board's daily decisions or just under the authority (direction) of the board of directors (which is more likely), assuming the delegation of powers from the board to the executive officers (management). But, unlike to European two tier systems, where any delegation to conduct the business to supervisory board is restricted and management board need no supervisory board delegation, for it is originally authorized by law, in the case of US, delegation must be made by the board of directors who originally is vested all powers by law.

As far as the powers to bind the corporation and to enter the business transaction, vested by law is concerned, US board is not comparable with European supervisory board but with management board (German: vorstand, French: directoire). But on the other side as concerns exercising monitoring as predominant de facto function US board it is only comparable with supervisory board.

In real life in big public corporations, it is obvious, that the board of directors do not conduct the business of the corporation in the sense of the day to day business decision making and monitoring the management at the same time, what by definition leads to separation of management from the board or from the supervision in US corporation as well as it is the case in the European two tier corporate structures. Unless vesting all corporate powers to single board, the separation of two functions (monitoring and operational) is made by delegation of powers related to conduct of business from the board of directors to executive management in the US corporation.

The main difference with the EU dual system is that US executive management powers are delegated by the board and can theoretically be changed any time but the powers of for

example German management board are vested by law and can not be decreased even by the shareholders resolution on the amendments to the articles. On the other side unlike US board of directors, German supervisory board has no powers to bind the corporation or to enter in any business transaction. That makes German and any other dual systems more legally certain and transparent for third parties.

The real relationship between the board of directors and the management of a big US corporation are best described in the following sentence:

"The board of directors do not itself manage the business of a large publicly held corporation; that is done by the corporate officers (the management). The board of directors participates in corporate affairs through its selection of chief executive officer and to some extent through the exercise of other functions as oversight the provision of advise to management, establishing of compensation level and so forth."

But on the other side in the case of "inside boards" composed by most or even all officers of the corporation, where chief executive officer is acting as a president of the board, directors have all power to make strategic and policy decision and to execute day to day operations. That includes the power to influence the choice of the members of the board what puts them into a position of acting satisfactory (so called yes-man board members) for chief executive officer an the rest of the executive management, what makes the monitoring performance less effective.

Speaking of the composition of US board, we must underline, that no mandatory rules are imposed to the shareholders in this concern, like it is known for at least mandatory employee participation in the supervisory and even in the management board in some European two-tier system legislation.

It is contrary to the concept of US corporate governance theory based on agency contract relationship between shareholders and the management, that the board should be composed out other constituencies than shareholders, or that the role of the board would be to represent harmonised interests of shareholders, or the interest of the corporation itself as an entity, rather than interest of individual or a certain group of majority shareholders.

In bigger publicly held corporation the real role that the board of directors actually perform, disregarding its de iure powers, is pretty much the same as to the role of the supervisory board in two tier system, and that is: monitoring, appointment and revoke the management and setting its remuneration.

The question that remains open in the European two tier systems too is to what extent board influences the overall strategy and policy of the corporation and its communications with the social environment. And of course big conceptual difference: supervisory board members are not the agents of the shareholders but act as the organ of a corporation as an institution, liable individually to act to the best interest of corporation as an entity, not to the benefit of individual shareholders.

Committees of the US board of directors

Under § 8.25 (a) MBCA 1984, a board of directors may create one or more committees and appoint members of the board of directors to serve on them, unless the articles of incorporation or bylaws provide otherwise. Each committee may have two or more members but they are at the same time members of the board.

As we have explained, US board of directors would normally delegate its duties to executive management, not to be involved in the detailed administration of the corporation. But certain specific duties can the board, according to the US corporate legislation, delegate to committees of the board composed normally of outside directors, in order to prevent the influence of insiders t their own position, neglecting by that the interest of the shareholders.

Committees of the board of directors are assuming increasingly important roles in the governance of publicly held corporations.

Executive committees have long provided guidance to management between meetings of the full board of directors. Audit committees also have a long history of performing essential review and control functions on behalf of the board of directors. In recent years nominating and compensation committees, composed primarily or entirely of non-management directors, have also become more widely used by publicly held corporations.

But certain duties are restricted from delegation and must be under ultimate direction of the board of directors. According to § 8.25 (d, e) MBCA, 1984, each committee may exercise the authority of the board of directors, though a committee may not, however authorize distributions and approve or propose to shareholders, fill vacancies on the board of directors or on any of its committees, amend articles of incorporation and adopt, amend, or repeal bylaws, approve a plan of merger not requiring shareholder approv¬al and authorize or approve reacquisition of shares, authorize or approve the issuance or sale or contract for sale of shares etc.

Section 8.25(e) MBCA, 1984 prohibits delegation of authority with respect to most merg¬ers, sales of substantially all the assets, amendments to articles of incorporation and voluntary dissolution under section 8.25(e)(2) MBCA, 1984 since these require sharehold¬er action. In addition, section 8.25(e) MBCA, 1984 prohibits delegation to a board committee of authority to declare dividends or distributions, designate director candidates for purposes of proxy solicitation, fill board vacancies, approve a so-called "short¬ form merger" (where the interest of the minority shareholders warrant special attention), authorize the disposition or reacquisition of shares, or amend the bylaws or the articles of incorporation (without shareholder approval under section 10.02 MBCA, 1984). On the other hand, under section 8.25 (e) MBCA, 1984, many actions of a material nature, such as the authorization of long-term debt and capital invest¬ment or the pricing of shares, may properly be made the subject of committee delegation .

Boards committees, composed of disinterested and independent members, are important mechanism for monitoring and specialised decision making, however it is clear that an action by the committee authorised to express powers of the board is considered to be an act by the entire board.

Official comment of MBCA states "Section 8.25 makes explicit the common law power of a board of directors to act through committees of directors and specifies the powers of the board of directors that are no delegable, that is, powers that only the full board of directors may exercise. According to Official comment of par 8.25 MBCA, 1984, the statement on non delegable functions is based on the principle that prohibitions against delegation should be limited generally to actions substantially affecting the rights of shareholders among themselves as shareholders and specifically to (1) those matters that have immediate and irrevocable effect (such as the declaration of a dividend), (2) those matters that may well become irrevocable without swift action, and (3) those matters that will cause changes of position by others that cannot be rectified.

As a result, delegation of authority to committees may be broader than mere authority to act with respect to matters arising within the ordinary course of business.
Shareholders Agreement on Powers of the US Board

As we have indicated before, MBCA 1984, section (8.01) requires that every corporation have a board of directors (except that with a shareholders agreement under section 7.32), and no other corporate bodies (supervisory etc.) are required in addition.

An agreement among the shareholders of a corporation which is effective among the shareholders and the corporation can eliminate the board of directors or restrict the discretion of powers of the board of directors (MBCA, 1984, par 7.32, a (1), or establishes who shall be directors or officers of the corporation, or their terms of office or manner of selection or removal (MBCA, 1984, par 7. 32, a (3).

The existence of the agreement must be noted; the failure to note the existence of agreement does not affect the validity of the agreement, but any purchaser of shares who at the time of purchase did not have knowledge of the existence of the agreement is entitled to rescission of the purchase (MBCA, 1984, par 7. 32. (c).

According to MBCA, 1984, par 7. 32 (d), an agreement ceases to be effective when shares of the corporation are listed on a national securi¬ties exchange or regularly traded in a market maintained by one or more members of a national or affiliated securities association.

Official comment to MBCA, 1984, par 7.32, states, that "shareholders of closely-held corporations, ranging from family businesses to joint ventures owned by large public corporations, frequently enter into agree¬ments that govern the operation of the enterprise. In the past, various types of shareholder agreements were invalidated by courts for a variety of reasons, including so-called "sterilization" of the board of directors and failure to follow the statutory norms of the applicable corporation act" .

According to Official comment to MBCA, 1984, par 8.1, the board of directors is the traditional but not the exclusive form of corporate governance in US corporation and "under section 7.32, an agreement among all shareholders can provide for a nontraditional form of corporate governance until there is a regular market for the corporation's shares, …

In Model Statutory Close Corporation Supplement (MSCCS) par. 20(a) (b). (Shareholder Agreements) it is said that all the shareholders of a statutory close corporation may agree in

writing to regulate the exercise of the corporate powers through an agreement that eliminates a board of directors, restricts the discretion or powers of the board or autho¬rizes director proxies or weighted voting rights; According to par.21. (a) Of MSCCS a statutory close corporation may operate without a board of directors if its articles of incorporation contain a statement to that effect. While a corporation is operating without a board of directors, all corporate powers are exercised by or under the authority of, and the business and affairs of the corporation man¬aged under the direction of, the shareholders (par.21. (c)). The shareholders by resolution may appoint one or more shareholders to sign documents as "designated directors." According to (MSCCS) par. 20 (b), an agreement is effective although its effect is to treat the corporation as a partnership; or it creates a relationship among the shareholders or between the shareholders and the corporation that would otherwise be appro¬priate only among partners.

MSCCS also states, an agreement restricting the discretion or powers of the board relieves directors of liability imposed by law, and imposes that liability on each person in whom the board's discretion or power is vested, to the extent that the discretion or powers of the board of directors are governed by the agreement.

Some other specifics of US single board (Number and Qualifications Requirements, Cumulative voting, Classified Board)

Most states in US permit board of directors to consist of one or two directors. There are some states that limit the right of having one or two directors to corporations with one or two shareholders. Par 8.03 of the MBCA, 1986 and statues of increasing number of states, any corporation may elect to have a board consisting of one or two directors without regard to the number of shareholders.

The number of directors of a corporation may be specified in or fixed in accordance with the articles of incorporation or by laws (MBCA, 1984, par. 8.03). The number of directors can be fixed by the board itself, if authorized by the articles or bylaws, or if the board is given the power to amend bylaws.

The number of directors can also be fixed by bylaws. The articles or the bylaws may create a variable range size of the board, so that the board may set the number of directors within that range; shareholders approval is needed for changes out of that limits, or for a change from a fixed to variable size, or vice versa (R MBCA, 1984, 8.03 c). The power of the board of directors to fix its size by shareholders approval is, unless it is not more than 30 %, restricted (R MBCA, 1984, 8.o3 b).

These provisions give a board a limited power to add certain number of members without shareholders approval or to decide not to file vacancies, but not unlimited power to make substantial changes. The policy, broadly accepted in the US, as regard to the right of board of directors to alter its size, therefore is, that there is very few limitation in this concern.

There are no mandatory qualifications requirements for corporate board members in US state corporate legislation. According to MBCA, 1984, par.8.02, a director need not be resident of the state or shareholder of the corporation unless article of incorporation or by laws so prescribe. That means that directors being authorized to amend by-laws can impose residency

or status of shareholder as a qualification for a director. But corporation is free to provide for special qualifications, in the Articles of incorporation¸ or the bylaws, such as requiring director to be a shareholder or a holder of shares of a specific class. It is on the other side quite usual to elect directors and officers among the shareholders. According to MBCA, 1984, par.8.03 a, only individuals may serve as directors, thus corporations may not serve as directors.

Cumulative voting means, that each shareholder has the number of votes equal to the numbers of shares owned. The shareholder may cast all his votes for a single director or apportion of the votes among the candidates. For example: a holder of 100 shares in a corporation with 10 directors would have 1000 votes, which he could cast for one candidate or distribute among up to 10 candidates. As a result through cumulative voting a minority shareholder can focus his voting power and may be able to elect one or more directors. The greater number of directors to be elected, the lower the level of support needed to elect at least one director.

Under MBCA, 1984 shareholders are not permitted to cumulate their votes unless the articles of incorporation provide otherwise. Shareholders must give a proper notice of their intent to vote cumulatively (RMBCA Act par.7.28, 1984). State codes regulate this issue very different, but the majority of them allow cumulative voting or allow if the corporation opts so (44 states); in other states cumulative voting is mandatory.

In classified board directors are divided into separate classes so that only one class of directors are elected each year. Normally boards are divided into three classes, so only one third of directors are elected each year.

According to MBCA, 19184, the article of incorporation may provide for staggering the terms of directors into two or three classes, each class to be as nearly equal in number as possible, provided that the board consists of nine or more directors (RMBCA, par 8.06, 1984). Classification of directors protects against sudden change in the board membership, despite changes in share holdings. In addition a classified board reduces the impact of cumulative voting, since a great number of votes are required to elect a director if the board is staggered than is required if the entire board were elected at each annual meeting.

MBCA (1984, par. 8.10 a) authorizes vacancies in the board of directors to be filled either by the shareholders or by the board of directors. Directors elected to fill the vacancies must stand for election at the next annual meeting of shareholders even if the term would continue beyond that meeting (R MBCA, 1984, par.8.05 b).

EU CORPORATE GOVERNANCE CONCEPT

Societas Europea – one or two tier system

The Council Regulation on the Statute for a European Company of the European Union (Regulation on SE) contains rules for European Public Companies known as a Societas Europaea (SE) (Latin for "European Company"). An SE can be registered in any member state of the European Union, and the registration can be easily transferred to another member state .

Societas Europaea must provide as governing bodies either a management board and a supervisory board (two-tier system) or an administrative board (single-tier system).
Under the two-tier system the SE is managed by a management board. The member or members of the management board have the power to represent the company in dealings with third parties and in legal proceedings. They are appointed and removed by the supervisory board. No person may be a member of both the management board and the supervisory board of the same company at the same time.

The following operations require the authorisation of the supervisory board or the deliberation of the administrative board:

- any investment project requiring an amount more than the percentage of subscribed capital;
- the conclusion of supply and performance contracts where the total turnover provided for therein is more than the percentage of turnover for the previous financial year;
- the raising or granting of loans, the issue of debt securities and the assumption of liabilities of a third party or suretyship for a third party where the total money value in each case is more than the percentage of subscribed capital;
- the setting-up, acquisition, disposal or closing down of undertakings, businesses or parts of businesses where the purchase price or disposal proceeds account for more than the percentage of subscribed capital;
- the percentage referred to above is to be determined by the Statutes of the SE. It may not be less than 5% nor more than 25%.

In the one tire system the member or members of the administrative board have the power to represent the company in dealings with third parties and in legal proceedings. Under the single-tier system the administrative board may delegate the power of management to one or more of its members.

Unlike US single board system the Regulation on SE introduces as a choice the separation of monitoring and business operational functions into two bodies, strictly separated between each other.

The Regulation on SE requires the EU countries to prescribe both one and two-tier system (i.e., a Managing Board and a Supervisory Board), but allows them to permit the company to have a choice between a two-tier system and a one-tier system (Managing Board only).

The management board, according to the Regulation on SE is not appointed by the shareholders like in US single board system, but by the supervisory board.

The most important conceptual difference between US single and EU two tier approach has to do with the question on whose behalf or to the benefit of whom, the corporate bodies should act. The Regulation on SE provides that all the members of the Managing and Supervisory Boards carry out their functions in the interest of the company, having regard to the interests of the shareholder and employees, which means that they may not serve the interests of either the shareholders or the employees only. This can only be explained by the fact that the EU Regulation on SE concept, unlike US one, does not disregard other than shareholder's constituencies of the corporation (for example: employees), and of course that

there is no doubt, that EU corporation (company) is an entity (institution) with its own interest.

The relation between the two bodies is seen from the obligations imposed to management board as regard keeping controlling body regularly informed, in order to enable it to intervene, if necessary. In addition the relations are determined by the fact that authorization (consensus) of the supervisory board can be imposed on the decisions of management board (see above).

As concerns the corporate governance under the Regulation on SE, there are thus two different systems legally regulated on disposal to the shareholders. One of them provides for one management organ only (composed by executive members, appointed only by the shareholders, and the majority of non executive members appointed partly by shareholders and partly by employees), while the other provides for two, namely a management organ responsible for managing the business of the company (appointed by controlling organ) and an organ responsible for controlling the management body (appointed partly by general meeting and partly by employees).

Even under the arrangement, which provides for only one management organ, a distinction must be made between executive members who manage the business of the company and non-executive members who confine themselves to supervision.

Employee participation in SE

The COUNCIL DIRECTIVE 2001/86/EC of 8 October 2001 supplementing the Statute for a European company with regard to the involvement of employees establishes rules on worker involvement in the management of the SE. The Council Directive on Employee Participation requires, (the Directive) that worker involvement provisions in the SE is to be decided upon by negotiations between employees and management before the creation of the SE.

According to the Directive (Article 2):

- information means the informing of the body representative of the employees and/or employees' representatives by the competent organ of the SE on questions which represent concern the SE.
- consultation means the establishment of dialogue and exchange of views between the body representative of the employees and/or the employees' representatives and the competent organ of the SE.
- participation means the influence of the body representative of the employees and/or the employees' representa tives in the affairs of a company by way of:
- the right to elect or appoint some of the members of the company's supervisory or administrative orga
- the right to recommend and/or oppose the appoint of some or all members of the company's supervisory or administrative organ

If agreement is not reached, provisions contained in the Directive that minimum percentage of employees from the entities coming together to form the SE ,enjoyed worker involvement provisions, apply.

Employee participation does not mean participation in day-to-day decisions, but participation in the supervision and strategic development of the company.
If the two parties do not reach a satisfactory arrangement, a set of standard principles set out in the Annex to the Directive becomes applicable.
Several models of participation are possible:

- a model in which the employees elect some of the members of the supervisory board or of the administrative board (in one tier system);
- a model in which the employees are represented by a separate body (workers council);
- other models to be agreed between the management or administrative boards and the employees or their representatives in those companies.

The employees' representatives must be provided with such financial and material resources and other facilities as enable them to perform their duties properly.
In order to make provision for employee participation, the described Directive does not make rules uniform for all the Member States but leaves them to choose between a numbers of equivalent arrangements.

EU member states differ in the degree of worker involvement in corporate management. In some countries corporations are required to allow employees to elect a certain percentage of members of the supervisory board. Other member states have no such requirement.
The laws of certain EU countries provide for employee participation within the supervisory or administrative organ but no such provision exists in others. According to directive, provision should be made for such participation in all EU countries. But in some countries employee participation through a body representing employees or through collectively agreed systems is a necessary first step.

The German two -tier board

German corporate governance system influenced a lot a ,number of European countries (for ex. Austria, France and Slovenia) to introduce different kinds of two tier systems in their legislation. Under German corporation law , unlike US, a stock corporation (Aktien Gesellschaft, AG) must have two different boards of directors: management board ("Vorstand" AktG, par.76 – 94), and a supervisory board ("Aufsichtsrat," par 95 - 117 Aktg). That makes German corporate governance system two-tier with strict separation of controlling (monitoring) function from the business conduct and with employee participation in both boards according to so called co-determination statues.

Managment board is responsible for the management and the day-to-day business of the corporation and therefore deals with third parties on behalf of the corporation. The management board has direct responsibility for the management of the corporation (par 76 AktG) and to the difference to US executive officers and committees has full legal power based on law to represent the corporation (par. 78 AktG). It has full authority and autonomy to make all decisions relating to the conduct the business and affairs of the corporation.

Restrictions on the authority to represent the corporation cannot be imposed neither by the (amendments of the) articles of incorporation nor by the shareholders resolution On the other side management responsibilities may not be conferred on the supervisory board, however the consent of the supervisory board can be imposed upon certain types of transactions .

The shareholders meeting may not decide on matters concerning the management of the company, unless it is required so, by the management board.

Main function of the supervisory board is to supervise the management of the corporation, and to appoint and to remove the members of the management board, to set compensation and enter into agreements with management board members on behalf of the corporation, here the conflicts of interests take place. Monitoring management what includes inspection and examination of the books and records, hearing reports, prepared by management board, imposing the authorization on managerial decisions, convening the shareholder's meeting , resolving the conflicts of interests and appoint, remove and compensate management are basically all relevant powers of the supervisory board under German law.

German supervisory board unlike US board of directors is de jure and de facto separated from the daily business conduct and could hardly directly take any advantage to its own benefit and damage shareholders interests. As for US board of director it need to be said that at least has the legal power to act in the name of corporation and thus potentially can threaten the shareholder's interests acting on his own benefit.

In AGs, which are subject to the Co-determination Acts 1951 or 1976, a labor director or "Arbeitsdirektor" who is in charge of personal and social matters must also be appointed.

The German management (executive) board runs the corporation and it makes all business decisions on its own responsibility based on law not the articles or supervisory board resolution. The two bodies are strictly separated and it is restricted that the member of management board would be at the same time the member of supervisory board. Delegation of powers is (with some exceptions) likewise restricted in both directions. The supervisory board may not interfere with the active management and cannot give to the management (executive board any binding instructions, whish is contrary to the situation in US where the board has original legal power to act, but delegates it to executives instead, who are any time subject to the board's instructions if any.

The supervisory board represents the company against the members of the management board. Management responsibilities may not be conferred on the supervisory board, but the articles of incorporations or the supervisory board may determine that specific types of transaction may be entered into only with the consent of the supervisory board. If the supervisory board refuses to grant the consent, the management board may request that shareholders meeting resolve whether to grant the consent with not less than three-fourths majority

According to German AktG management board must report on its activities to the supervisory board, which enables supervisory board to perform its supervisory duties of the conduct of the business executed by the management board.

In addition the management board must inform the chairman of the supervisory board of any important circumstances affecting the corporation. This includes information related to affiliated corporations (subsidiaries) that could have a substantial impact on corporate situation . Moreover the supervisory board may at any time demand from management (executive)) board additional reports on any matter relevant to the corporation state of affairs.

According to par. 83 AktG the management board has to prepare and execute the resolutions of shareholders meeting. It applies to prepare matters, which fall within the competence of the shareholders meeting, including agreements, which become effective only with the consent of the shareholders meeting. This generally applies to the execution of any resolution adopted by the shareholders meeting in respect of matters falling within its competence. Disagreements between the management (executive(and supervisory board can be brought before the shareholders meeting for decision (AktG, par. 173/1).

An AG must have at least one director; companies with higher authorized share capital must have two directors unless the articles of association provide otherwise (par.76/2, AktG).

There are special requirements for appointments to the manangement board for AGs, which are subject to the Co-determination Acts 1951 or 1976; namely a labor director or "Arbeitsdirektor" who is in charge of personal and social matters must also be appointed.

The supervisory board of an AG must have at least 3 members. The article of association may provide for a higher number, which must be divisible by three and must not exceed the maximum number of 21 members permitted under the Stock Corporation Act. The members are divided into representatives of the employees and/or representatives of the shareholders. Natural persons (individuals) can only be members of the supervisory board, with the exception of members of the board of directors, legal representatives of a dependent company, legal representatives of a second company in which one member of the executive board of directors is a member of the supervisory board and individuals who are members of more than nine other supervisory boards.

Business partners, bank representatives and others who have business alliances with the corporation are not excluded from being supervisory board member, what remains the issue of disinterested directors so much discussed in US theory unsolved.

The members coming from the shareholders' side are elected by the shareholders themselves. The employees' representatives are elected in accordance with the requirements of the applicable Co-determination Act. The articles of association can provide rights for certain shareholders holding a specified number of shares to appoint a member of the supervisory board. The members can be removed at any stage by a mandatory prescribed three-quarters majority decision. Moreover, a member of the supervisory board can be removed for important reasons by way of a court decision; the supervisory board decides on the filing of such an application by simple majority.

Similarly to US board of directors, Supervisory board may appoint among its members one or more committees. However certain duties may not be referred to committees to decide, as for the ex.: -advanced payments of dividends (par. 59/3 AktG), -issue by laws (par.77/2 AktG), -appointment and removal the management board (par 84/2 and 3 AktG), -call the shareholder

meeting (par 111/3 AktG), examination of the annual financial statement and annual reports and the proposal for appropriation of distributable profits including the affiliated enterprises (par 171 and 314/2 AktG)

The role of German committees is pretty different to the one of US board committees, which is related to the issue of independency of decision making on certain matters. In the case of German committees it is more the matter of preparing the deliberations and resolutions and supervising the execution of supervisory board resolutions.

Committees though do not solve the problem of not disinterested directors (business partners, banks representatives, etc.) that may sit in the Supervisory board according to German legislation.

Conduct of corporation

Management Board could be compared by officers of the corporation or by individual manager (chief executive). Both of them conduct day to day business and represent corporation towards third parties an thus can be regarded as agents of the corporation. Of course there is an important legal difference between US management and German Management Board:

For ex. German management board's legal position is defined by law and could not be changed by articles of incorporation or shareholders decision which is not the case with US management, that is officers and chief executive of the corporation, whose position depends on the decision of the Board of directors; they are delegated certain, normally very extensive powers, but still their positions fully depends on decisions of the board of directors.

German management board is thus:

- more autonomous towards Supervisory Board and statutory authorized for all transactions with third parties that cannot be restricted by anybody including shareholders; there is even the restriction for Supervisory Board to delegate it any powers referring to day to day business conduct
- under monitoring and supervision by Supervisory Board what prevent Management Board to enter into the transaction that damage shareholders interests

Supervisory board members are not agents of the corporation

First of all, what we can compare with US Board of directors, is supervisory board and not management board. But unlike US board members, supervisory board members are not entitled to represent corporation and enter any transaction that bind corporation and affect shareholders. Their power is limited to supervise the conduct of management, to appoint and to revoke management board members, to set remuneration for them and to give consent and opinions to certain managerial actions, depending on the articles.

Supervisory board is by all means a typical a monitoring body but its more than that: it protects the interests of all shareholders on the principle of equal treatment of shareholders trying to harmonize the interest of all shareholders to a synthesis which is a corporations own

interest But there are substantial differences between the two bodies that make some US theoretical issues especially those related to agency cost theory basically inapplicable to German experiences and vice versa.

Agency cost theory that tries to align the board members and shareholders' interests assuming the conflict of interests by definition, seems to be an “aberatio ictus”, considering that supervisory board members are not entitled to enter in to any transaction on behalf of the corporation. How could then they abuse their position by acting on they own behalf and damage shareholder’s interests, when they cannot act at all? The discussion over the mechanisms to prevent board members to satisfy they own interests instead the interests of shareholders is in the case of supervisory board less interesting.

The biggest difference between the two systems is thus that US board member unlike supervisory board is originally (by law) entitled to enter into business transaction on behalf of corporation any time. At least theoretically (according to the theory of agency costs this is its basic principle) the US board of directors is no doubtfully the agent of the shareholders to the difference with the German supervisory board member who is restricted to enter in any business transaction but those when they represent corporation in conflicts of interests and legal actions against management board members.

Supervisory board members are not representing the corporation, they are not the agents of the corporation and they can hardy abuse their position to threaten shareholders interests. Supervisory board members are by definition independent for nobody of them is employed in the corporation.

But there is no rule prohibiting employment of a supervisory member in an interested or competitive corporation, what makes the issue of independency rather important.

CONCLUSIONS

The corporate structure in two tier systems is based on the splitting of powers between the stockholders’ meeting and the supervisory board. There are strictly separate areas of responsibility. The general meeting decides on questions of the status, capital, related extraordinary corporate changes, conforms the distribution of profits and nominates supervisory board and auditors.

Management board conducts the company’s business on its own responsibility and basically no interference with its performance from the side of shareholders or anyone else is permitted.

Management board in addition represents the corporation and no limitation of representation can be imposed to management powers to represent corporation, laid down by law.

Supervisory board controls the conduct of business performed by the management board, but has no power to make any decision concerning day-to-day business. Management board is not authorized to transfer any powers of business decision making neither to supervisory board nor to general shareholders meeting.

There is, however, a big difference between the one tier concept of US and UK corporate governance on one side and German or Austrian, French or any other two-tier concepts.

Similarly to US law where shareholders agreements on powers and even existence of board of directors under certain circumstances are permissible, under UK law shareholders can reserve for themselves certain powers conferred on them by the memorandum and the articles. On the other hand shareholders' resolution can even modify powers given to directors in the articles or memorandum. The resolution of shareholders can enlarge their powers in relation to their powers conferred on directors in the articles or in memorandum. Shareholders' decision can thus overrule the powers of management stated in the articles or in memorandum .

Undoubtedly, there is an important difference between the two concepts, which does not reflect just the fact that there is no supervisory board in the US law. It has to do with legal position of the management board, which is in German law much more autonomous and independent from the shareholders. That causes necessary changes in the regulation of responsibility of directors.

There is no doubt that there is a direct correlation between the specific corporate governance system and the efficiency of a corporation. Which of the two systems is more efficient, not considering very important aspects of ownership structure, remains a question that is beyond legal analyse of the problem.

But there are a number of important differences referring to the structure of corporate governance between US and EU countries, that we can summarize, as follows:
1.Two bodies are regulated in EU legislation (administrative and controlling organ, or Management and Supervisory board), compulsory in Germany and Austria and some other countries or upon choise, like in France (Conseil d'admministrative and Conseil d'surveillance) and only one in USA (Board of directors).
One of the most important differences lies in the fact that EU proposed legislation (proposed fifth directive and proposed Statute for European company) is mandatory employee participation in the Supervisory and the Management (Executive) board for example in Germany, recommended in EU directive and to a certain extent in France and some other EU countries on one side and no such rules at all in USA.
That doesn't mean, that US corporate law system prohibits employee participation, but rather to enforce it by mandatory prescription it leaves it again to the partner's dialog in a corporation on the principles of contractual freedom. That makes US corporate legal system again more flexible and liberal rather than administrative and imposing general ideas to everyone, be it applicable or not.
If these relations in the EU countries with employee participation tradition would have been left to the contractual dialog between the management and employee representatives on a corporate level, like it is in US, without any mandatory rules, it is sure that no employee participation would be the case in real life. But knowing the social partners equilibrium, in the countries where it is now mandatory implemented, such a reform to existing mandatory legislation would hardly be supported by sufficient majority.
2.There is further on no doubt that US corporate law permit delegation of duties of the board of director to officers, board committees, etc., as long as their management is »under ultimate

direction of the board«. But the variety of possible relations exist between the board of directors and the management related to the composition of the board with regard to the existence and extent of outside directors in the individual corporation.
In short, major differences between the US and German model would be the following:

- US board of directors has to the difference to the German supervisory board full power to operate business and enter in any legal transaction unless it delegates the power to executives, what it usually does; German supervisory has no power to enter into legal transaction, it is even restricted that the right to conduct the business would be transferred to supervisory board even by Articles of incorporation..
- After delegation of power to chief executive officer, the de facto position of US board is pretty much the same than the position of German supervisory board (mainly monitoring the performance of executives) and the position of German management board nearly the same as the one of US chief executive officer.
- But de jure difference is substantial: US board has statutory power to operate business transaction while the German supervisory board has not any. Thus US board is responsible for overall business performance, while German supervisory board only for efficient supervision.

3. The fact is that US Board of directors is becoming more and more monitoring and supervisory organ (at least in big corporations) with the representation of the majority of outside and independent members and delegating more and more executive functions to executive and other comities. On the other side the German Supervisory board is in addition to its supervisory function strengthening its strategic role in a German corporation.
Outside and inside directors in US are comparable by UK ordinary and service or working directors. The ordinary directors hardly attend the board meetings, but service directors, bound by employee contracts devote full time to the company and actually carry out day-to-day business or appoint one of them to perform that as managing director.
This concept can in addition be compared to the one -tier system in France, where the chairman of the board (also the president) is the chief executive officer, who is responsible for day-to-day management of the corporation. Since chairman is vested nearly all powers for the conduct of the business, board meetings are relatively seldom and other directors are mainly concerned with long term policy and to supervise the conduct of a company.
This brings US outside directors, UK ordinary directors and French members of the board in the pretty much the same position to supervise the president and the executive directors. The president is on the other side in all systems in similar position to char the board that supervises his managerial activity and even presides his supervisors.
4. But clear distinction must be made between delegation of duties of the board to executive committee and statutory duties of, for example, German vorstand (management board) or French conseil d'administrative (administrative counsil), both executive bodies under the supervision of supervisory board in two-tier system. In the case of German two-tier system we can not speak of delegation of duties for example from Supervisory to Management (executive) Board, because the two organs derive their duties of law not one from another, as it is the case in the relationship between the board of directors and executive (or any other) committee. Management (executive) board legal position is independent towards the Supervisory board and doesn't need its authorisation to act in conducting the corporation, as it is the case with Executive and other comities of the US board of directors
Thus Management (executive) board of, for example German corporation has no analogy with US board of directors, nevertheless it performs the conduct of the business of a corporation, like US Board of directors does. There is more legal similarity between the

German Supervisory board and the US Board of directors than between the latter and the German Management (Executive) board and there is very little legal similarity between the German Management (Executive) board and the US Executive committee. The differences affect the issue of fiduciary duties and liability, which we discuss separately.

5. The differences are therefore not so big, as they appear at the first glance and there is a substantial convergence between the two systems. Differences are of course big, when we speak on statutory model of theoretically ideal nonexistent corporation. But in real life US system has created not a supervisory body but supervisory function performed by outside directors and developed executive structures (CEO, executive and other committees) that perform exactly the same operations that German management board does.

On the other side, although German supervisory board is statutory strictly separated from management (executive) board members, in meetings they sit together and the management board members play a central role proposing corporate strategies and policy. The supervisory board further on cannot play any important role if management board members are represented by and informally instructed by strong institutional shareholders. Again, business organisational theory argue that operation and control are two parts of management as a function that can not be separated from each other, especially not in two bodies. Management (executive) board has an important influence to the proposals for the elections of supervisory board members, as the CEO to the election of the UC board of directors.

Last but not least the competence of supervisory board members from the point of view the time they are ready to invest in implementation of their duties is quite comparable with US outside directors. Does the advantage of having just professionals managing the business prevails over the disadvantage that nobody is capable to supervise them and are left without supervision? Obviously the answer lies in the market and its ex post control and reactions over the performance of the professionals.

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CORPORATE GOVERNANCE, RELATED LATED PARTY TRABSACTION AND BANK PERFORMANCE

Chuang-Min Chao, National Taipei University of Technology
Jia-He Jhuang, National Taipei University of Technology
sonya2468@hotmail.com

ABSTRACT

This study attempts to examine the structure of ownership, composition of board, and the connection between the related party transaction and the firm performance. Many empirical literatures on board composition , ownership structure and related party transactions just focus on firm valuation; they generally treat board composition and related party transactions as exogenous. But the recent studies (e.g., Hermalin and Weisbach, 1988; Yeh and Woidtke,2005) argue that board composition is not an exogenous. In order to deal with endogeneity problem, this study applies two stage least square method (2SLS) and assumes that board composition and related party transaction are endogenous variables. The sample banks used in this study are those banks listed in TSEC or OTC from 2003 to 2007. This paper sheds light on these questions while taking into account the endogeneity of the relationships among corporate governance, corporate performance, the related party transaction, and corporate ownership structure. This paper contributes to the literature by taking into account of the endogeneity problem. We find that banks with corporate governance that are more effective in monitoring and advisory terms are better governed, and that better governance creates shareholder value.

Keywords: Corporate governance, Related party transactions, Endogeneity, Commercial banks

INTRODUCTION

Recently, there are many financial crises around the world. The major crisis in the history is the Asian financial crisis in 1997 and the accounting fraud of Enron and World Com in 2002. The scandals and corruptions let the regulators and researchers realize the importance and urgency of implementing good corporate governance for publicly held companies. As a result, corporate governance has become an important research issues in the recent literature, and governments of various countries are urged to strengthen the corporate governance mechanism.

Is corporate board structure indicative of corporate governance in firms with concentrated ownership? Does shareholder concentration allow controlling shareholders to select board members that are more likely to monitor or provide expertise? Or does shareholder concentration allow controlling shareholders to select board members that enable them to expropriate wealth from minority shareholders? Does the independence of the board appear to matter in firms with concentrated ownership? These are important questions that have not been fully addressed in the literature. Existing studies on corporate boards of directors are generally restricted to large US firms with disperse ownership, and they generally treat board composition as exogenous (see

Hermalin and Weisbach, 2003, Yeh and Woidtke ,2005). It remains an open question whether results in existing studies can be generalized to firms with controlling shareholders.

On the other hand, Firms which are affiliated to a conglomerate usually form an intra-group financial network that allows redistribution of resources across the membership firms. The redistribution is performed in many different ways, such as transfer pricing, providing loans, paying special dividends, making new equity issues and asset sales, and the extreme form of cash appropriation. For example, Gopalan, Nanda, and Seru (2007) find that intra-group loans are an important means of transferring funds among Indian group affiliated firms. Chang and Hong (2000) find that Korean business conglomerates use practices like debt guarantees, equity investments and internal trade. Claessens et al. (2002) find that relative firm value increases with concentrated ownership of the largest shareholder but decreases as the wedge between control and ownership increases in family-controlled firms. They suggest that family-controlled firms can more efficiently divert resources to themselves than widely held corporations and financial institutions. One would expect the role of the board to be especially important in such situations – situations where complex pyramiding and cross-holding schemes make it more difficult for minority shareholders to monitor and easier for controlling families to divert resources to themselves.

Taiwan represents an ideal setting to examine these issues because it features relatively weak protection of minority shareholders, high ownership concentration, a predominance of family control, and an abundance of pyramidal groups and cross-holdings – characteristics common to many countries (La Porta et al., 1999; Claessens et al., 2000; Faccio and Lang, 2002).Therefore, this study is going to examine whether the redistribution of resources among group members (i.e., related party transactions) would benefit or harm the performance of the banks in the conglomerates, and the relationship between ownership structure, board composition, related party transaction, and the banks' performance.

Previous empirical literatures on the topics regarding board composition, related party transactions and banks' performance usually treat board composition and related party transactions as exogenous variables. However, Yeh and Woidtke (2005) find that the board composition is correlated with the ownership structure, because the controlling shareholders may be able to select board members. Hermalin and Weisbach (1988) also argue that board composition is not exogenous. In addition, corporations with wrose corporate governance mechanism are more likely to use related party transactions to expropriate firm's resources and damage investors' rights.

Therefore, this study is going to examine the relationship between ownership structure, board composition, related party transaction, and the banks' performance. The sample banks used in this study are those banks listed in TSEC or OTC from 2003 to 2007. In order to deal with endogeneity problem, this study applies two stage least square method (2SLS) and assumes that board composition and related party transaction are endogenous variables.

LITERATURE REVIEW

Corporate governance in Taiwan

Several internal and external governance mechanisms in the US – such as ownership by institutions, the market for corporate control, and the composition of the board of directors – may provide incentives for managers to maximize shareholder wealth. However, the degree to which these mechanisms come into play can vary dramatically across countries. For example, Yeh et al. (2001) find that Taiwanese listed companies have similar ownership characteristics to publicly traded companies in most countries around the world. They are characterized by a high degree of ownership in general and are predominantly family-controlled (see La Porta et al., 1999; Claessens et al., 2000; Faccio and Lang, 2002, for ownership characteristics in countries around the world). However, unlike the US, Taiwan is characterized by low institutional ownership and an inactive market for corporate control. Moreover, stockholders have fewer rights in Taiwan than in the US, though they have approximately the same number of rights as the average reported for 49 countries in La Porta et al. (1998). Thus, Taiwan provides a natural setting for examining the influence of positive incentive and negative entrenchment effects on board composition. Our results are more likely to be indicative of the board's role in most countries than results using US firms, not only because large shareholders are more likely to play an important role in director selection but also because alternate corporate governance mechanisms are less likely to play as critical a role in countries where family control is predominant.

Corporate boards in Taiwan

Similar to German boards, corporate boards in Taiwan are comprised of two separate organizations – a board of directors and board of supervisors. Directors are responsible for managing the company, while supervisors are responsible for monitoring the directors. Specific director responsibilities include the following: managing business operations; appointing, dismissing, and compensating management; appointing, dismissing, and compensating external auditors; legally representing the company within the limits of their authority; and approving equity and debt issues. Managerial decisions within a firm are determined by the vote of its directors during board meetings. The minimum number of directors required by law for our sample of Taiwanese firms is three. On the other hand, supervisors do not participate in the decision-making or the voting process but are designated to monitor the board of directors. They are responsible for scrutinizing decisions made by directors, reviewing and auditing the reports provided by directors, and resolving any disputes arising between shareholders and directors. The supervisors are to oversee business operations and can investigate a firm's finances or operations at any time. Moreover, supervisors can individually exercise their rights. A consensus is not required. For example, a single supervisor can require directors or managers to address any question or concern (s)he has regarding the company's operations or financial statements. If the supervisor finds the directors or managers have either transgressed the law or hurt firm value, (s)he can sue the directors or managers. Because supervisors can individually exercise their rights, Taiwanese companies tend to have a small number of supervisors. The minimum requirement by law for our sample of Taiwanese firms is one supervisor. Unlike German boards, Taiwanese boards of directors and supervisors are parallel organizations. In other words, supervisors do not have the right to approve directors' decisions. Even though they may ask

managers or directors to address questions, directors and managers have some influence over what information is given to supervisors. Thus, a lawsuit is unlikely unless a supervisor is willing to actively monitor and investigate directors' or managers' actions. Moreover, Taiwan's Corporate Law stipulates that both supervisors and directors are to be elected by shareholders and only current shareholders are qualified candidates, but the regulations do not stipulate that independent directors or independent supervisors must be included on a corporation's board. Even though Taiwan's Corporate Law stipulates that no current employees or directors can serve as supervisors, it does not prohibit family members of current employees or directors from serving as supervisors. As a result, it is common to see family members of controlling shareholders serve as supervisors. In addition, because Taiwan's Corporate.

Tunneling and propping

Empirical evidence shows that in large parts of the world many firms belong to business groups characterized by complex ownership structures, which often take the form of a pyramid (La Porta et al., 1999; Claessens et al., 2000). These firms are controlled through a chain of companies, where firm A holds part of firm B's shares, which in turn holds part of firm C's shares, etc. The ultimate controlling shareholder, who is in control of firm A and thereby of 'lower-level' firms B, C, etc., is often a wealthy family. The family uses indirect ownership to exert control over the firms belonging to the pyramidal chain. This implies that she is able to maintain control of the lower-level firms without a majority of cash-flow rights, thus creating a separation between control rights and cash flow rights. This separation between ownership and control provides the controlling shareholder with incentives to engage in selfdealing transactions at the expense of minority shareholders. That is, the controlling shareholder may find it profitable to transfer resources from a firm in the pyramidal chain to herself or to another (usually a higher-level) firm, at the expense of the minority shareholders of the former firm. Examples of these transactions are abound and include internal asset sales, equity sales, transfer pricing contracts that benefit other firms in the pyramid, and outright cash appropriation. In this paper, we analyze whether such self-dealing transactions provide a justification for the existence of the pyramidal ownership structure. Outright cash appropriation and other resource transfers directly to the family's own pockets are generally considered illegal and face severe punishments. However, interfirm transfers of resources within a business group, generally known as related-party transactions, are often considered legal, at least under some countries' jurisdictions. Djankov et al. (2008) define these legal related-party transactions as actions taken by controlling shareholders which 'may benefit them at the expense of other investors, but follow the law regarding disclosure and approval procedures.' The different legal treatments of related-party transactions across countries reflect differences in their legal systems and court interpretations.

EMPIRICAL ANALYSES

This brief review of the inter-relationships among corporate governance, related party transactions and corporate performance, suggests that, from an econometric viewpoint, to study the relationship between corporate governance, related party transactions and performance, deal with endogeneity problem ,one would need to formulate two stage least square method equations that specifies the relationships among the abovementioned variables. We specify the following

system of three simultaneous equations:

$$\begin{cases} Y_{i1t} = \alpha_1 + \beta_1 RDen_{i1t} + \beta_2 STR_{i1t} + \beta_3 BDen_{i1t} + \beta_4 Board_{i1t} + \beta_5 RPT_{i1t} + \beta_6 SIZE_{i1t} \\ \qquad + \beta_7 LEV_{i1t} + \varepsilon_{i1t} \\ RPT_{i2t} = \alpha_2 + \beta_1 RDen_{i2t} + \beta_2 STR_{i2t} + \beta_3 BDen_{i2t} + \beta_4 Board_{i2t} + \beta_5 MORTGAGE_{i2t} \\ \qquad + \beta_6 OWNER_{i2t} + \beta_7 BLOCK_{i2t} + v_{i2t} \\ Board_{i3t} = \alpha_3 + \beta_1 RDen_{i3t} + \beta_2 STR_{i3t} + \beta_3 BDen_{i3t} + \beta_4 BODSIZE_{i3t} + \beta_5 CEODIR_{i3t} \\ \qquad + d_{i3t} \end{cases} \quad (1)$$

Where the $\varepsilon_{i1t}, v_{i2t}, d_{i3t}$ are the error terms. The estimation issues for the above equations are discussed in the next section.

Sample selection and data

We use financial data from Taiwan Economic Journal, and Market Observation Post System database of regional banks in Taiwan. It is covering periods from fiscal 2003 through fiscal 2007. Total sample have 32 banks.

Corporate governance variables

Board internalization
The number of directors affiliated with the largest shareholder group divided by the total number of directors.

Ownership network density (ODen)

This variable related to the degree of shareholder relationship density; we calculate it by summing the relationship linkage values and dividing the values by the amounts of shareholder members, and then timing 100%. In this study, we define three relationship of linkage: investment, headquarters- subsidiaries, and brother. We use values 0 and 1 to indicate that whether the relationship existing. We build a matrix to construct these relationship network values, for that we can use the social network analysis software UCINET to get the value of bank ownership network density.

Table.1 Network density marix

	A	B	C	D
A	1	0	0	1
B	1	1	1	0
C	0	1	1	0

D	1	0	0	1

UCINET 6.05 (Borgatti, Everett, and Freeman, 2002) is a comprehensive program for the analysis of social networks and other proximity data. It is the best known and most frequently used software package for the analysis of social network data and contains a large number of network analytic routines.

Group network density (RDen)

The variable RDen related to the degree of related company relationship density, likes ODen, we calculate it by summing the relationship linkage values and dividing the values by the amounts of all board members, and then timing 100%. In this study, we define the relationship of linkage: the cross-holding linkage to other firms within same group. We use values 0 and 1 to indicate that whether the relationship existing. We build a matrix to construct these relationship network values, for that we can use the social network analysis software UCINET to get the value of bank group network density.

Related party transactions

Lending business to related party /total assets refer to related party transactions, which are disclosed in annual reports

Performance variable

We use the annual accounting data from Market Observation Post System database in Taiwan for calculating return-on-assets ("ROA"). We calculate ROA as the income after extraordinary items, interest expense, and taxes, divided by the average of the two most recent years of total assets.

Instrumental variables

We define ceo chair-duality a dummy variable that takes the value of one when the ceo and the chairman of the board are the same person, and zero otherwise. Board size is the total number of directors, obtained from Taiwan Economic Journal. Total assets (Ln) is the natural log of firm's assets. Leverage is a firm's total debt divided by total assets. Shareholding ratio(Owner) is the proportion of shares or cash flow rights owned by total number of directors and supervisors. Pledged ratio(MORTGAGE) is control is the proportion of shares or votes controlled by the largest shareholder group, ownership is the proportion of shares or cash flow rights owned by the largest shareholder group , The ratio of ownership to control. Block holder is a dummy variable that equals one when a second shareholder owns more than 5% and equals zero, otherwise. Complexity of ownership structure (STR) is a variable that takes the value of one when exist pyramid structure or cross-holding, takes the value of two when exist pyramid structure and cross-holding, and otherwise zero.

EMPIRICAL RESULT

Mode.1:

$$Board_{i3t} = \alpha_3 + \beta_1 RDen_{i3t} + \beta_2 STR_{i3t} + \beta_3 BDen_{i3t} + \beta_4 BODSIZE_{i3t} + \beta_5 CEODIR_{i3t} + d_{i3t} \qquad (1.1)$$

Table.2 Regression results 2003-2007

Model	Source	Sum of Squares	df	Mean Squares	F	Sig.
Board	Regression	2.93638303	5	.587276607	11.93	.000

Residual	7.43324376	151	.04922678		
Total	10.3696268	156	.066471967		

Model		Coef.	Std. Err	t	P>|t|	[95% Conf.	Interval]
Board	str	.1414737	.0290397	4.87	0.000	.0840972	.1988503
	oden	.1050396	.0499962	2.10	0.037	-.203822	-.0062571
	ceodir	.1385173	.1144625	1.21	0.228	-.0876376	.3646722
	bodsize	-.0189506	.0053314	-3.55	0.001	-.0294843	-.0084168
	block	-.2081806	.060206	-3.46	0.001	-.3271355	-.0892257
	_cons	.9979622	.0823648	12.12	0.000	.8352258	1.160699

From Table.2 we can find the significant positive relationship between ownership and board internalization.

Mode.2:

$$RPT_{i2t} = \alpha_2 + \beta_1 RDen_{i2t} + \beta_2 STR_{i2t} + \beta_3 BDen_{i2t} + \beta_4 Board_{i2t} + \beta_5 MORTGAGE_{i2t} + \beta_6 OWNER_{i2t} + \beta_7 BLOCK_{i2t} + v_{i2t} \quad (1.2)$$

Table.3 Instrumental variables (2SLS) regression 2003-2007

Model	Source	Sum of Squares	df	Mean Squares	F	Sig.
RPT	Regression	.070985849	7	.010140836	5.86	0.0000
	Residual	.257980412	149	.001731412		
	Total	.328966261	156	.002108758		

Model		Coef.	Std. Err	t	P>|t|	[95% Conf.	Interval]
RPT	bard	.040263	.0221873	1.81	0.072	-.0841053	.0035793
	str	.0312003	.0060674	5.14	0.000	.019211	.0431896
	oen	.020359	.0097974	2.08	0.039	-.0397188	-.0009991
	rden	.0292082	.014859	1.97	0.051	-.0585698	.0001534
	block	.0222922	.0117607	1.90	0.060	-.0009471	.0455314
	owner	.0132053	.0143252	0.92	0.358	-.0151015	.0415122
	mortagage	.0414262	.019623	2.11	.036	.0026508	.0802016
	_cons	.0429824	.0179371	2.40	0.018	.0075385	.0784263

From Table.3 we can find the significant positive relationship cross ownership complexity board internalization and related party transactions.

Mode.3:

$$Y_{i1t} = \alpha_1 + \beta_1 RDen_{i1t} + \beta_2 STR_{i1t} + \beta_3 BDen_{i1t} + \beta_4 Board_{i1t} + \beta_5 RPT_{i1t} + \beta_6 SIZE_{i1t} + \beta_7 LEV_{i1t} + \varepsilon_{i1t} \quad (1.3)$$

Table.4Instrumental variables (2SLS) regression 2003-2007

Model	Source	Sum of Squares	df	Mean Squares	F	Sig.
ROA	Regression	5657.79464	7	808.256377	27.93	0.0000
	Residual	4311.17866	149	28.934085		
	Total	9968.9733	156	63.903675		

Model		Coef.	Std. Err	t	P>|t|	[95% Conf.	Interval]
ROA	board	3.804344	2.295024	1.66	0.099	-.7306547	8.339342
	str	-3.353978	.8103915	-4.14	0.000	-4.955322	-1.752634
	oden	-5.486136	1.321008	-4.15	0.000	-8.096465	-2.875807
	rden	-2.005326	1.983377	-1.01	0.314	-5.924505	1.913853
	rpt	34.02062	12.86873	2.64	0.009	8.591842	59.4494
	ln	6.03072	.5391284	9.38	0.000	3.990053	6.120702
	lev	5.055377	3.291526	1.83	0.069	-.473379	12.53482
	_cons	-90.41382	9.826618	-9.20	0.000	-109.8313	-70.9963

From Table.4 we can find the significant negative relationship between ownership complexity and bank performance. Board internalization, related party transactions, and bank performance are the significant positive relationship.

CONCLUSION

We examine whether a firm's corporate board is indicative of its corporate structure in an environment where ownership is complexity, and analyze interrelations between corporate governance mechanisms and asset appropriation and derive hypotheses. Existing studies indicate that ownership structures tend to be concentrated in most countries outside the US. Yet studies on corporate boards of directors are generally restricted which ownership is disperse, and treat board composition as being exogenous. Our results suggest that: first, controlling shareholders influence the board selection process, and board structure is indicative of the quality of its corporate governance when ownership is complexity. Second: empirical analysis identified corporate governance that could help to significantly improve internal and external governance structures and reduce tunneling. In contrast, ownership complexity, board composition and group network density does not foster internal governance mechanisms to reduce operational tunneling. Moreover, the resulting finds that relative firm value increases with ownership increases in family-controlled firms. They suggest that family-controlled firms can more efficiently divert resources to themselves than widely held corporations and financial institutions. One would expect the role of the board to be especially important in such situations – situations where complex pyramiding and cross-holding schemes make it more difficult for minority shareholders to monitor and easier for controlling families to divert resources to themselves.

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ON THE RELATIONSHIP OF THE OFF-BALANCE SHEET ACTIVITIES AND THE THREE RISK TYPES OF THE NEW BASEL ACCORD

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Yu-Ling Hsiao, National Taipei University of Technology, Taiwan
Karen740105@hotmail.com

ABSTRACT

The most people always thought the off-balance sheet (OBS) activities could increase the potential risks of the banks. And the Basel Accord assumes the off-balance-sheet activities to increase the bank risk and gives the weights. The rates of the weights range from 0% to 100% to risk-based capital. However, the findings of many empirical studies on the relation of off-balance-sheet activities and bank risk reveal their negative relationship instead. This study uses Seemingly Unrelated Regression Model (SURE) to investigate the influence of off-balance sheet (OBS) activities on the three risk types of the New Basel Accord, i.e., the market risk, the credit risk, and the operational risk. When calculating the risks, standardized approach is used to calculate the credit risk and the market risk, and basic indicator approach is used to calculate the operational risks. And the sample banks in this study are the 36 Taiwan banks from 2005 to 2007. As the result, we can see the relationship between the off-balance sheet activities and three risk types of the New Basel Accord. In this study, we can't find significant relationship on them. Bank regulators should re-think the effects of the off-balance sheet activities on bank risks when assigning the weights to the risk- based capital.

Keywords: off-balance sheet (OBS), New Basel Accord, Seemingly Unrelated Regression Model (SURE)

INTRODUCTION

Banking industry has been playing a significant role in the process of economic development of Taiwan. There exists an inseparable relationship between its operation quality and the steady growth of national economy. Nevertheless, the drastically increasing numbers of banks in recent years have caused a vicious competition in this industry. Meanwhile, the global economic recession also leads to the continuous rise of the percentage of nonperforming loans, ever-reducing profit earnings as well as the financial chaos and crisis in the banking industry. In order to improve the bank profit earning, each bank starts to develop

off-balance sheet (OBS) activities.

The most people always thought the off-balance sheet (OBS) activities could increase the potential risks of the banks. And the Basel Accord assumes the off-balance-sheet activities to increase the bank risk and gives the weights. The rates of the weights range from 0% to 100 % to risk-based capital. However, the findings of many empirical studies on the relation of off-balance-sheet activities and bank risk reveal their negative relationship instead. Therefore, this study is going to investigate the relationship between the off-balance sheet activities and three risk types of the New Basel Accord.

In June 2004, the Basel Committee for Banking Supervision released its reform of the capital adequacy framework originally introduced with the 1988 Accord. This reform is based on three mutually reinforcing pillars: (i) minimum capital requirements, (ii) supervisory review process, and (iii) market discipline. As far as the first pillar is concerned, the New Accord is based on minimum capital requirements for credit, market and operational risks. Credit risk capital requirements, in turn, would be set according to a standardized approach or an internal rating-based approach. Market risk capital requirements would be set according to a standardized approach or an internal models approach. Operational risk capital requirements would be set according to a basic indicator approach, standardized approach or a advanced measurement approach.

But in Taiwan, Taiwanese banks use standardized approach for the credit risk and the market risk, and most banks use basic indicator approach for the operational risks. Therefore, when calculating the risks, standardized approach is used to calculate the credit risk and the market risk, and basic indicator approach is used to calculate the operational risks in this study.

This paper proceeds as follows. Section 2 reviews the literature that focuses on the off-balance sheet activities sector. Section 3 presents the data and variables and provides a brief discussion of SURE. Section 4 discusses the empirical results, and Section 5 concludes the study.

LITERATURE REVIEWS

A number of studies have examined the key motivations behind bank OBS activities; however, the results have been mixed. Pavel and Phillis (1987) and Baer and Pavel (1987) suggest that banks engage in loan secudtization and standby letters of credit (SLCs) in order to reduce regulatory taxes, such as capital adequacy requirements. In contrast, Benveniste and Berger (1987) and Koppen haver (1989) find that the bindingness of capital constraints are

not an important factor in banks' decisions to engage in OBS activities. Moreover, Avery and Berger (1991) and Jagtiani (1995) find that better performing and more creditworthy banks tend to issue more OBS commitments and swaps - a finding that appears inconsistent with the capital avoidance hypotheses. The purpose of this paper is to revisit the issue of capital requirements and OBS activities by modelling each OBS activity as an innovation whose adoption follows a diffusion pattern specific to that activity. It has been shown that the adoption patterns of real innovations often follow a logistic time curve. We model the diffusion of bank OBS activities: interest rate swaps, SLCs, loan securitization, interest rate options, and interest rate futures and forwards, in a similar fashion. That is, OBS financial innovations (HOBS) are expected to grow over time as OBS financial technology is diffused among banks.

Within the context of a diffusion model, we examine various factors that may be important in determining OBS growth. These factors include several important changes in capital requirements. Arguably, the 1985 increase in U.S. banks' capital requirements, based only on bank on-balance sheet assets, may have induced banks to undertake greater OBS activities, causing the OBS growth rate to exceed that predicted by the 'pure' diffusion model. Conversely, risk-based capital (RBC) requirements, which were approved in July 1988 and based on OBS as well as on-balance sheet activities may have discouraged OBS growth. Our analysis includes both an examination of capital regulation on FIOBS for the industry as a whole and for individual banks. The latter allows us to explore the effects of factors that are specific to individual banks.

METHODOLOGY

Data

We use financial data from Taiwan Economic Journal, Central Bank of China, and annual report form the sample banks.The sample banks in this study are the 36 Taiwan banks from 2005 to 2007. And there are Taiwan Bank, Land Bank, Taiwan Cooperative Bank, First Bank, Hua Nan Bank, Chang Hwa Bank, City Bank, Shanghai Commercial & Savings Bank, Taipei Fubon Bank, Cathay Bank, Export-Import bank, Kaohsiung Bank, Mega Commercial Bank, China Development Industrial Bank, Taiwan Industrial Bank, Taiwan Business Bank, Sandard Chartered Bank, Taichug Bank, King’s Town Bank, Hwa Tai Bank, Shiin Kong Bank of Taiwan, Sunny Bank, Panhsin Bank, COTA Commercial Bank, Union Bank of Taiwan, Far Eastern International Bank, Yuanta Bank, Sinopac Bank, Esun Bank, Cosmos Bank, Taishin International Bank, Ta Chong Bank, Jih Sun International Bank, En Tie Commercial Bank, Chinatrust Bank ,and Chinfon bank.

SURE estimation

This study is going to investigate the relationship between the off-balance sheet activities and three risk types of the New Basel Accord. But the standard error of variance possibly neglects the influence of time, which causes some kind of degree related of residual item, result in the non-diagonality of the error covariance matrix usually entails that individual equation estimates are sub-optimal. Therefore, we use Seemingly Unrelated Regression Model (SURE) to solve this question in this study.

The Seemingly Unrelated Regressions Model(SURE) introduced by Zellner (1962). The SURE speci1cation is expressed as a set of linear regressions where the disturbances in the different equations are correlated. The non-diagonality of the error covariance matrix usually entails that individual equation estimates are sub-optimal; hence, generalized least squares (GLS) estimation which exploits the correlations across equations may improve inference. However, the implementation of GLS requires estimating the error covariance from the data. Further the cross-equation dependence must be taken into account when testing cross-equation parameter restrictions. As it is well known, feasible generalized least squares (FGLS) estimators need not be more efficient than ordinary least squares (OLS). Indeed, the closer the error covariance comes to being spherical, the more likely it is that OLS estimates will be superior. This has extensively been discussed in the SURE literature. In this sense, choosing between GLS and OLS estimation in the SURE model corresponds to the problem of testing for sphericity of the error covariance matrix.

Consider the seemingly unrelated regression model, each of which satisfies the assumptions of the standard regression model:

$$Y_i = X\beta + u \qquad i=1,\ldots,p \tag{1}$$

And Y_i is a vector of n observations on a dependent variable, and the above regression equation may rewrite the following matrix:

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_p \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_p \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_p \end{bmatrix} \tag{2}$$

$$\text{And, } Y=\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_p \end{bmatrix}, \; X=\begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_p \end{bmatrix}, \; \beta=\begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{bmatrix}, \; u=\begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_p \end{bmatrix} \tag{3}$$

Where Y and u each have dimension (np)*1, X is a (np)*k matrix and β has dimension k*1. So, we can stack all the equations together into a system of the OLS form as in (1). This suggests as an estimation procedure to run OLS on this system, i.e. to consider $\hat{\beta}$.

$$\hat{\beta}=(X'X)^{-1}\,X'Y \tag{4}$$

System OLS estimation

Consider the estimator $\hat{\beta}=(X'X)^{-1}\,X'Y$ .In this section I will show that this estimator is equivalent to running OLS equation by equation. Consider first the matrix $X'X$ and notice that it's block diagonal where each block is of dimension $K_i * K_i$:

$$\begin{bmatrix} X'_1 & 0 & \cdots & 0 \\ 0 & X'_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X'_p \end{bmatrix}\begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_p \end{bmatrix}=\begin{bmatrix} X'X_1 & 0 & \cdots & 0 \\ 0 & X'X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X'X_p \end{bmatrix} \tag{5}$$

Therefore, we can invert the whole matrix $X'X$ by inverting each of it's diagonal matrices. Second notice that we can write $X'Y$ as:

$$\begin{bmatrix} X'_1 & 0 & \cdots & 0 \\ 0 & X'_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X'_p \end{bmatrix}\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_p \end{bmatrix}=\begin{bmatrix} X'_1Y_1 \\ X'_2Y_2 \\ \vdots \\ X'_pY_p \end{bmatrix} \tag{6}$$

This gives us the following expression for $\hat{\beta}$ which shows that system OLS is equivalent to running OLS equation by equation.

$$\hat{\beta}=\begin{bmatrix} (X'_1X_1)^{-1} & 0 & \cdots & 0 \\ 0 & (X'_2X_2)^{-1} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & (X'_pX_p)^{-1} \end{bmatrix}\begin{bmatrix} X'_1Y_1 \\ X'_2Y_2 \\ \vdots \\ X'_pY_p \end{bmatrix}=\begin{bmatrix} (X'_1X_1)^{-1}X'_1Y_1 \\ (X'_2X_2)^{-1}X'_2Y_2 \\ \vdots \\ (X'_pX_p)^{-1}X'_pY_p \end{bmatrix} \tag{7}$$

System GLS estimation

Let's consider the model (1) more in detail. So far nothing has been said about the covariance matrix of U. If we assume E(U) = 0 then the variance covariance matrix of U is follow.

$$\sum U \equiv \mathrm{E}\begin{pmatrix} u_1 \\ \vdots \\ u_p \end{pmatrix}\begin{pmatrix} u_1' & \cdots & u_p' \end{pmatrix} = \begin{pmatrix} \mathrm{E}u_1u_1' & \cdots & \mathrm{E}u_1u_p' \\ \vdots & \ddots & \vdots \\ \mathrm{E}u_pu_1' & \cdots & \mathrm{E}u_pu_p' \end{pmatrix} \tag{8}$$

Notice that in the case where all classical assumption for each equation are satisfied we are only imposing the following structure on ΣU:

$$\Sigma\mathrm{U} = \begin{pmatrix} \sigma^2{}_1\mathrm{I}_{\mathrm{K}_1} & \cdots & \mathrm{E}u_1u_p' \\ \vdots & \ddots & \vdots \\ \mathrm{E}u_pu_1' & \cdots & \sigma^2{}_p\mathrm{I}_{\mathrm{K}_p} \end{pmatrix} \tag{9}$$

It follows from the Gauss-Markov Theorem that the estimator in the previous section will be efficient only under very strong assumptions. As suggested in the remark the system OLS estimator will not be efficient under a very general set of assumptions. The reason this is so can be understood by thinking of the system OLS estimator as running OLS on a model with non spherical error term. This is the problem that the GLS estimator solves, hence we can apply it also in this context to gain in efficiency:

$$\hat{\beta}_{GLS} = (X\Sigma_U{}^{-1}X)^{-1}(X\Sigma_U{}^{-1}Y) \tag{10}$$

Variables

We adopt Seemingly Unrelated Regression Model (SURE) in this study. And the dependent variables are market risk, credit risk, and operational risk. The independent variables are three Off-balance Sheet variables and six In- balance Sheet variables. There are loan commitment (v1), guarantee service (v2), and derivative (v3). And three of them are major research variables in our study. The other six variables are Total Asset (v4), Total Debt (v5), Capital (v6), Deposit Gross (v7), Loan Gross (v8) , and Bad Debt Allowance (v9). We use these Off-balance Sheet variables and In- balance Sheet variables to investigate the influence of off-balance sheet activities on the three risk types of the New Basel Accord.

The credit risk is the risk of a loss due to default. And we choose standardized approach of Basel Ⅱ for credit risk in our study. Standardized Approach is based on each risk weight of

customers, external choosing rules and risk mitigation. The market risk includes the risk of a loss due to unanticipated price movements in financial securities or asset values, and it includes price fluctuations due to equities, interest rates, commodities, or foreign currencies. And we choose standardized approach of Basel Ⅱ for market risk in our study. In Basel Ⅱ, the market risk is the sum of interest risk, equity and security risk, exchange risk and product risk. The operational risk is defined as the risk of loss resulting from the inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk. And we choose basic indicator approach of Basel Ⅱ for operation risk in our study. Basic Indicator Approach is based on single indicator(α) to calculate operation risk.

Model establish

Our model as follow:

$$Y_1=X_1\beta_1+u_1 \quad (11)$$
$$Y_2=X_2\beta_2+u_2$$
$$Y_3=X_3\beta_3+u_3$$

Y_1 is credit risk, Y_2 is operation risk, and Y_3 is market risk. And X_1=[v1 v2 v3 v4 v5 v8 v9], X_2=[v1 v2 v3 v4 v5 v7 v8], and X_3=[v1 v2 v3 v4 v5 v6]. And we use the above-mentioned to investigate the purpose of this study.

EMPIRICAL RESULTS

Seemingly unrelated regression

Table1

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
cred	105	7	.895694	0.4946	119.34	0.0000
oper	105	7	.4010554	0.8241	499.65	0.0000
mark	105	6	.9408877	0.4863	102.00	0.0000

Table2

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
cred						
v1	-.0018403	.0008113	-2.27	0.023	-.0034304	-.0002503
v2	.0094096	.0047411	1.98	0.047	.0001173	.0187019
v3	-.0001588	.0001119	-1.42	0.156	-.0003781	.0000605
v4	-.2042728	.6282972	-0.33	0.747	-1.435713	1.027167
v5	.2581218	.7327567	0.35	0.725	-1.178055	1.694299

v8	.2936477	.5752443	0.51	0.610	-.8338103	1.421106
v9	.6463562	.1742267	3.71	0.000	.3048781	.9878342
_cons	.4014473	1.726854	0.23	0.816	-2.983124	3.786019

Table3

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
oper						
v1	.0004654	.0003768	1.24	0.217	-.000273	.0012039
v2	-.0024273	.0021822	-1.11	0.266	-.0067044	.0018498
v3	.0001855	.000051	3.64	0.000	.0000856	.0002854
v4	1.799871	.4234151	4.25	0.000	.9699925	2.629749
v5	.1678937	.4914807	0.34	0.733	-.7953907	1.131178
v7	.4550613	.2046869	2.22	0.208	.0538823	.8562403
V8	-1.653055	.351277	-4.71	0.000	-2.341545	-.9645645
_cons	-6.683909	1.545141	-4.33	0.000	-9.712329	-3.655489

Table4

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
mark						
v1	-.0005155	.000828	-0.62	0.534	-.0021383	.0011073
v2	.0064507	.0048035	1.34	0.179	-.0029641	.0158654
v3	.0000531	.00012	0.44	0.658	-.000182	.0002882
v4	1.669786	.8139454	2.05	0.040	.0744824	3.26509
v5	-.9873127	.7243189	-1.36	0.173	-2.406952	.4323264
v6	.2575642	.1973425	1.31	0.192	-.1292199	.6443483
_cons	-4.728541	1.777006	-2.66	0.008	-8.211408	-1.245673

CONLUSIONS

As the result, we can see the relationship between the off-balance sheet activities and three risk types of the New Basel Accord. In this study, we can't find significant relationship on them. Bank regulators should re-think the effects of the off-balance sheet activities on bank risks when assigning the weights to the risk- based capital. After having more understanding of the relationship between the off-balance sheet (OBS) activities and the three risk types of the New Basel Accord, we expect that banks could improve the mechanism of risk management and avoid possible bankruptcy risks.

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A ROUGH SET-BASED APPROACH TO SELECTION OF CRUCIAL FEATURES IN NEW SERVICE CONCEPTS

Mr. Changyong Lee, Seoul National University, Korea
akuta7@snu.ac.kr
Dr. Hyeonju Seol, Korea Air Force Academy, Korea
hyeonju.seol@gmail.com
Mr. Changho Son, Seoul National University, Korea
c13981@snu.ac.kr
Dr. Yongtae Park, Seoul National University, Korea
ytpark@snu.ac.kr

ABSTRACT

A number of service features may describe new service concepts (NSCs) from a variety of perspectives, but at the same time, could cause difficulties in further investigation. The issue of paring down to a set of essential service features is important in practice. In response, we propose a rough set-based approach to the selection of crucial features in NSCs. The rough set theory (RST) is effective for data reduction in qualitative as well as quantitative analyses. Taking the advantages of RST, the proposed approach is comprised of five stages, Firstly, the feature candidates are defined through reviewing relevant studies and conducting interviews with domain experts. The second stage deals with the exploration of possible shapes for each feature candidate. Thirdly, the decision table is constructed by assigning the most appropriate shapes to feature candidates. Fourthly, the redundancies between feature candidates are analyzed by discernibility matrix and function. Finally, the crucial service features are identified through applying the absorption law to the discernibility function. This study first adopts the RST in the research area of new service development (NSD), and is conductive to NSD studies in various ways. First and foremost, the proposed approach promotes rapid and efficient consensus building about the most crucial features of NSCs. Second, it can be employed when the data set is small in size. Finally, it can be integrated with related methods for the systematic development of NSCs. Put together, the proposed approach is expected to efficiently facilitate the concept development in NSD.

Keywords: New service development, Concept development, Feature selection, Rough set theory

INTRODUCTION

Along with the service sector's increased importance, new service development (NSD) has likewise become an increasingly integral part of business concerns (Lundkvist and Yakhlef, 2004). Service firms are forced to continuously and successfully provide new services for survival (Shostack, 1984; Meyer and DeTore, 2001); consequently, there are rising attempts to formalize the NSD process using suitable models, methods, and tools. Similar to the case of new product development (NPD), the NSD process consists of several stages starting from idea generation to post-launch (Bullinger et al., 2003). Among them, concept development is one of the most crucial stages since it directly influences the direction of remaining activities, customer satisfaction, and differentiation (Johne and Storey, 1998; Alam and Perry, 2002; Chai et al., 2005).

The concept development in NSD is more obscure than that in NPD due to the intangibility and incompleteness of new services (Syson and Perks, 2004). Products can be depicted with concept sketches and annotations of key features (Ulrich and Eppinger, 2003), but it is difficult to analyze and describe the exact concepts and benefits of services. Although previous studies on service modeling have discussed a number of service features that should be considered when developing NSCs, they contain too many service features to implement at the concept development stage. The issue of paring down to a set of essential features is important in practice. Moreover, the service features introduced are by no means fixed and exhaustive. Crucial features may differ across the context of NSD such as type of industries and type of approaches to NSD. Nevertheless, despite its importance, the question of how to systematically select the crucial service features has rarely been dealt with (Wu and Wang, 2005; Kim et al., 2008). In response, the primary purpose of this study is to propose a systematic approach to selection of crucial features in NSCs.

The feature selection problem needs to address the following two issues. The first issue is the number of service features. A number of features may describe NSCs from a variety of perspectives, but at the same time, could cause difficulties in further investigation. The complexity of concept combination table (morphology analysis) increases by geometric progression in the concept generation stage, and more profiles are required to conduct conjoint analysis in the concept evaluation stage, as a service feature is added. Thus, the minimal set of service features, which is jointly sufficient and individually necessary for preserving the same information, should be identified. The second issue is how to manipulate the qualitative information. Since the service features are qualitative as well as quantitative ones, the feature selection in NSD involves the processing of qualitative information, instead of numerical expressions and objective decisions.

Under such considerations, we propose a rough set-based approach to selection of crucial features in NSCs. The underlying methodology, rough set theory (RST) is effective for data reduction in qualitative as well as quantitative analyses. Taking the advantage of RST, the proposed approach is mainly comprised of five stages. Firstly, the feature candidates are defined through reviewing relevant studies and conducting interviews with domain experts. The second stage deals with the exploration of possible shapes for each feature candidate. Thirdly, the decision table is constructed by assigning the most appropriate shapes to feature candidates, respectively. Fourthly, the discernibility matrix and discernibility function are derived to analyze the redundancies between feature candidates. Finally, the crucial service features are identified through calculating the discernibility function.

This study first adopts the RST in the research area of NSD, and is conductive to the related studies in various ways. First and foremost, the proposed approach promotes rapid and efficient consensus building about the crucial features of NSCs. Second, it can be employed when the data set is small in size. Finally, it can be integrated with related methods such as concept combination table, conjoint analysis, and quality function deployment, to make up for the weak points of aforementioned methods. Put together, the proposed approach is expected to efficiently aid the concept development in NSD.

The remainder of this paper is organized as follows. Section 2 reviews the underlying methodology of the proposed approach, RST. The proposed approach is explained in Section 3. Finally, the paper ends with conclusions in Section 4.

ROUGH SET THEORY

Conventional methods for data reduction are population-based approaches which may require several statistical assumptions, and are subject to limitations in dealing with the qualitative information. In this respect, the RST, originally introduced by Pawlak (1982), is effective in data reduction of qualitative as well as quantitative information that is difficult to analyze by conventional statistical techniques (Tseng and Huang, 2007). Moreover, it can be employed when the data set is small in size (Khoo et al., 1999). It is usually difficult to collect a large amount of data at the concept development phase, and thus the conventional population-based approaches can hardly be utilized. Put together, the RST appears to be a suitable method for the selection of crucial features in NSCs.

There have seen a huge increase in the use of the RST. The RST has been employed in various areas such as business failure prediction (Beynon and Peel, 2001; Lin et al., 2009), product quality evaluation (Zhai et al., 2002), customer relationship management (Tseng and Huang, 2007), environment quality evaluation (Ip et al., 2007), supply chain management (Xia and Wu, 2007; Su et al., 2008; Li et al., 2008), product design (Tseng and Huang, 2008, Shao et al., 2009), fault diagnosis (Geng and Zhu, 2009), Kansei Engineering (Zhai et al, 2009), customer satisfaction analysis (Chen, 2009), R&D management (Wu, 2009). The basic concepts of RST are briefly explained in the following sub-sections.

Decision table

The rough set-based analysis starts with the development of a decision table containing data about objects characterized in terms of certain attributes. The decision table can be defined as *(U, A)* where U is the universe (a finite set of objects, $U=\{x_1, x_2, \ldots, x_n\}$) and A is the set of attributes that can be divided into condition and decision attributes. The condition attributes can be regarded as descriptive parameters while decision attributes can be viewed as classification parameters. The attribute $a \in A$ defines an information function $f_a: U \rightarrow V_a$, where V_a is the domain of attribute a.

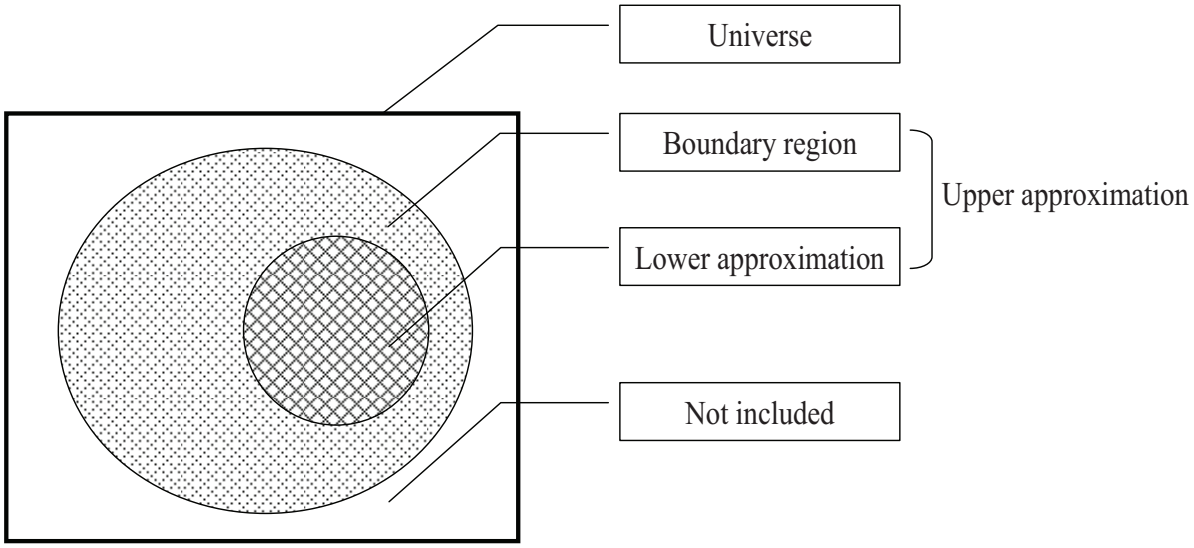

Figure 1. Schematic demonstration of RST

Lower and upper approximation

In the RST, any vague concept can be represented as a pair of precise concepts using lower and upper approximations (Pawlak, 2002). As Figure 1 shows, the lower approximation set *Apr* has all objects that can be certainly included in *X*, on the other hand, the upper approximation set *Apr* consists of the elements which cannot be characterized with certainty as belong or not to *X* (Greco et al., 2001). The difference set *Bnd* is called a boundary region composed of the elements that can neither be ruled in nor ruled out as member of the target set.

Core and reduct

The derivation of core and reduct aims to cut the redundant attributes so as to facilitate the better understanding and decision making (Wu, 2009). The reduct is defined as the subset of attributes which is jointly sufficient and individually necessary for preserving the same information or property as that is provided by the entire set of attributes (Zhao et al., 2007) while the core is the common part of all reducts. The discernibility matrix and discernibility function are used to derive the core and reduct. The discernibility function *f(A)* is constructed based on the discernibility matrix containing the attributes whose values are different between objects. The *f(A)* is comprised of a series of Boolean functions such as OR (+) and AND ( ). The discernible attributes between two objects are first combined by OR, and then they are connected by AND. Finally, the core and reduct are obtained to apply the absorption law to the discernibility function (e.g., a_1 $(a_1 + a_2 + a_3) = a_1$).

PROPOSED APPROACH

This section examines the overall process of proposed approach, giving a brief explanation of each stage at the same time. The proposed approach is mainly comprised of five stages, as shown in Figure 2. Firstly, the feature candidates that need to be considered when developing NSCs are defined through reviewing relevant studies and conducting interviews with domain experts. The second stage deals with the exploration of all possible shapes for each feature candidate. Thirdly, the decision table is constructed by assigning the most appropriate shapes to feature candidates, respectively. Next, the discernibility matrix and discernibility function are derived to manipulate the redundancy between feature candidates. Finally, the crucial features of NSCs are identified through calculating the discernibility function.

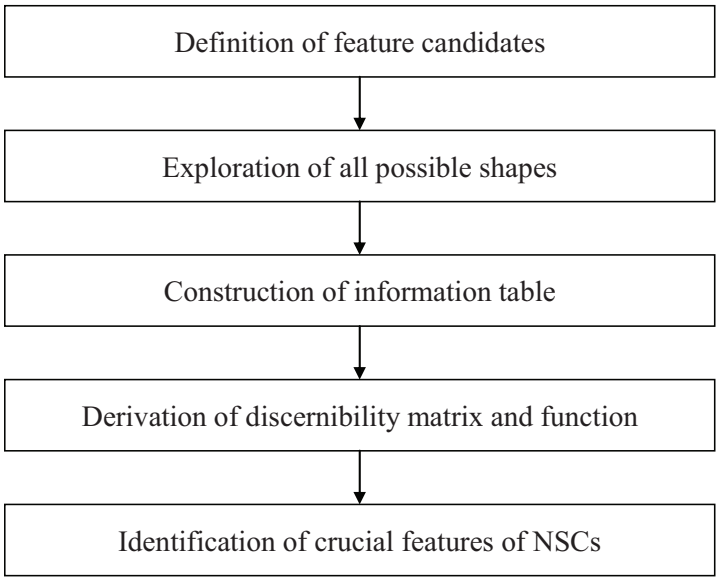

Figure 2. Overall process

Definition of feature candidates

Reviewing previous studies on service and business modeling revealed the service features that need to be considered when describing NSCs. Edvardsson and Olsson (1996) and Lovelock et al. (1999) suggested the "What and How" approach to definition of service concept. "What" is defined as the customer benefit while "How" is referred to the service delivery from the perspectives of service marketing and operation, respectively. Clark et al. (2000) and Johnston and Clark (2001) distinguished the service concept framework into four dimensions: service operation, experience, outcome, and value. Meiren (1999) and Bullinger et al. (2003) proposed a service modeling framework composed of resource, process, and product. Eriksson and Penker (2000) categorized the business model components into four types: goal, resource, process, and rule. Osterwalder (2004) mentioned product, infrastructure management, customer interface and financial aspects in the business model ontology that was extended by Pigneur (2002) and Lambert (2007). The feature candidates are defined by adding or removing the aforementioned service features.

Exploration of possible shapes for feature candidates

This stage arranges all possible shapes where each feature candidate can manifest itself. Taking the restaurant service as an example, the possible shapes for types of cooking can be 1) make to order, 2) make to stock, 3) design to order, and 4) assemble to order.

Development of decision table

The decision table is constructed for feature selection in NSCs. The table contains data about the most appropriate shapes for each feature candidate, as shown in Table 1. In the table, five experts assigned the most appropriate shapes to each feature candidate. "No matter" indicates that no differences exist among possible shapes with respect to the appropriateness for the feature candidate.

Table 1. Decision table for feature selection in car-sharing service

	Model	Vehicle	Fuel	Garage	Operation	Customer	Dep.

Expert 1	Commute	Small	Electricity	10 min.	One-way	Thirties	Account.
Expert 2	Commute	Small	Electricity	10 min.	One-way	Thirties	Manuf.
Expert 3	Leisure	SUV	No matter	20 min.	Roundtrip	No matter	Des. Eng.
Expert 4	Leisure	SUV	Electricity	20 min.	One-way	Thirties	Marketer
Expert 5	Business	Small	Gasoline	10 min.	One-way	Thirties	Des. Eng.

Derivation of discernibility matrix and function

The discernibility matrix and discernibility function are derived to manipulate the crucial features of NSCs. The elementary sets are first found, and then the discernibility matrix is constructed through comparing the elementary sets. The feature candidates rated as "No matter" do not appear in the discernibility matrix because "No matter" implies that no differences exist between the experts. For example, if ES 1 = {red, No matter, 5 min.} and ES 2 = {red, 1 km, 10 min.} are two elementary sets in the decision table whose attributes are a_1, a_2, and a_3, then the discernible attribute between ES 1 and ES 2 is only a_3. The discernibility function *f(A)* is constructed based on the discernibility matrix developed.

Identification of crucial features

The core and reduct are obtained by applying the absorption law to discernibility function. The reduct is interpreted as the subset of attributes which is jointly sufficient and individually necessary for preserving the same information of NSC as that is provided by the entire set of attributes. Thus, the core is the crucial features of NSCs.

CONCLUSION

A number of service features may analyze and describe NSCs from a variety of perspectives, but at the same time, could cause difficulties in further investigation. The issue of paring down to a set of essential service features is important in practice. This study proposed a rough set-based approach to selection of crucial features of NSCs. The RST was successfully employed for identifying the crucial service features.

This study first adopts the RST in the research area of NSD, and is conductive to the NSD studies in various ways. First and foremost, the proposed approach promotes rapid and efficient consensus building about the most crucial features of NSCs. Second, it can be utilized when the data set is small in size. Finally, it can be integrated with related methods such as concept combination table, conjoint analysis and quality function deployment to make up for the weak points of the aforementioned methods. Taken together, the proposed approach is expected to efficiently facilitate the concept development in NSD.

Nevertheless, this study is subject to several limitations that stand in the way of our future research plans. Firstly, this study does not provide the specific guidelines for integration with related methods. The detailed procedures with inputs and outputs will be discussed in the future study. Secondly, the future research will also include a case study involving the application of proposed approach to a real world problem. These can be fruitful areas for future research.

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The Impact of Collective Nature of Team Members on New Product Development Performance: the Organizational Routines Perspective

Hong-Chun Wang*, National Cheng Kung University, Taiwan
alexwanghongchun@yahoo.com.tw
Ya-Jung Wu, Kao Yuan University, Taiwan
yajungwu@yahoo.com.tw

ABSTRACT

The main purpose of the present paper is to explore how the cognitive heterogeneity of NPD team members affects the characteristics of the routines of NPD, then the outcome performance. In the remarkable book by Nelson and Winter (1982), An Evolutionary Theory of Economic Change, the authors prospered the concept of organizational routines. Over two decades, the literature applied this concept still remains an ambiguous definition (Becker, 2004). Winter (1982: 263) once defined the routine is a "pattern of behavior that is followed repeatedly, but is subject to change if conditions change." Koestler (1964) also defined routines as "flexible patterns offering a variety of alternative choices." The definition of organizational routines as 'recurrent interaction patterns' gradually gets a common place (Becker, 2004). In the NPD field, the literature relevant to task itself such as task complexity, task interdependence has accumulated much works. However, the nature of 'collective' included the recurrent interaction patterns is still under exploration. Therefore, this study will try to discuss the influence of the collective nature of team members on the NPD performance through the organizational routine under some situations such time pressure, environment uncertainty.

We propose some propositions in this study are the following:

1) *the higher level of cognitive heterogeneity will result in the higher sequential variety of interactive patterns and higher explorative performance under low time pressure and low environment uncertainty; on the other hand,*
2) *the higher level of cognitive heterogeneity will result in the lower sequential variety of interactive patterns and higher exploitative performance under high time pressure and high environment uncertainty.*

Keywords: Organizational routine, New product development, Behavioral theory of the firm, Simulation

INTRODUCTION

The firms are modeled as having certain capabilities and decision rules. Over time, these capabilities and rules are modified as a result of both deliberate problem-solving efforts and random events. And the market determines which firms are profitable and which are not will play a natural selection mechanism. The evolutionary theory prospered by Nelson and Winter (1982) is unabashedly Lamarckian: it contemplate both the 'inheritance' of acquired characteristics and the timely appearance of variation under the stimulus of adversity.

Developing new products continuously has been recognized as a necessary competence to gain the competitive advantage in the rivalry world. The relevant issues for new product development has attracted much research in various fields of management scholars (Gerwin and Barrowman, 2002; Shane and Ulrich, 2004).
Organizational researchers have long been interested in the determinants and consequences of organizational routines (Becker, 2005).

In the following section, we make the literature review, especially try to clarify the concept of organizational routines contextualized in the NPD. Based on the literature review, we propose some propositions in this study. Finally, we propose some theoretical and managerial implications for discussion.

Theoretical Background

New Product Development

The new product development frameworks in the most literature are based primarily on three different systems views: linear, recursive, and chaotic. Linear NPD frameworks interpret the process of innovation as a series of events and activities, which are sequential and discrete in nature. Recursive NPD frameworks seek to represent the events in which activity is multiple, concurrent, and divergent, in which the process includes feedback and feed-forward loops. Thus, recursive frameworks assert that NPD stages overlap, creating fuzziness and disorder in the process. The chaotic view assumes that chaotic behavior can occur in NPD process and depicts highly innovative NPD processes as systems with random-like and nonlinear behavior that generate irregular or disordered actions. McCarthy et al. (2007) proposed NPD as a complex adaptive system, which is somewhere between a linear and a chaotic system, with partially connected agents whose decision making and interactions produce behavior and outcomes that are neither fully controlled nor arbitrary. A CAS uses four systems dimensions:

(1) the number of elements that make up the system; (2) the attributes of the elements; (3) the number and type of interactions among the elements; and (4) the degree of organization inherent in the system.

Gerwin and Barrowman (2002) drew the integrated product development perspective to conduct a meta-analysis study for new product development literature. This paper indicates the relationship between four IPD characteristics and project performance, respectively named NPD process, product definitions, organizational context, teaming, development time, and goal failure.

Winter and Szulanski (2001) argued replication strategy as a process that involves a regime of exploration in which the business model is created and refined, followed by a phase of exploitation in which the business model is stabilized and leveraged through large-scale replication. Similar to their argument, the new product development should be viewed as an organizational routine that involves an explorative regime which a new product-market area is created, discovered, and refined, followed by an exploitative phase which the product attributes are stabilized and leveraged through replication.

The type of new product (Crawford and Di Benedetto, 2003) – new-to-the-world, new category entries, additions to product lines, product improvement, and repositionings.
Sheremata (2000) proposed centrifugal and centripetal forces that influence the outcomes of problem-solving, then influence the goal attainment in radical new product development under time pressure. Such two kinds of forces exist somehow countervailing effects, the author argued the interactive effect for the NPD goal attainment. Only the situation with both high forces can achieve successful radical new products.

Krishnan and Ulrich (2001) induced a decision perspective in their meta-analytic study of product development. They organize product development decisions into two broad categories: within a development project and setting up a development project. The former is divided into four categories: concept development, supply-chain design, product design, and production ramp-up and launch; the latter is divided into three categories: product strategy and planning, product development organization, and project management.

Organizational Routines

Winter (1964: 263) once defined the routine is a “pattern of behavior that is followed repeatedly, but is subject to change if conditions change.” Koestler (1964) also defined

routines as "flexible patterns offering a variety of alternative choices." The definition of organizational routines as 'recurrent interaction patterns' gradually gets a common place (Becker, 2004).

The concept of an organizational routine is interpreted in at least three ways (Becker, 2004): behavioral regularities; rules, standard operating procedures; and dispositions.
The content of the patterns: action, activity, behavior and interaction. Both of behavior and interaction are subsets of action. Routines are understood as activity patterns; as opposed to that, routines can also be understood as cognitive regularities or cognitive patterns. Then, routines would be understood as rules: 'if {condition A}, then {do B},' for instance, heuristics and rules of thumb, industry recipes, standard operating procedures, and programs.

Pentland and Feldman (2005) also proposed three different ways that treat organizational routines as a unit of analysis. They are to treat the entire routine as an undifferentiated 'black box', to study particular parts of the routine in isolation, and to study the relationships between these parts and the processes by which the parts change. Compare to the first one, the authors argued we need to unpack the routine. There are three possibilities to consider: (1) the ostensive aspect, (2) the performative aspect, and (3) the related artifacts.

As Winter (2003) argued "the ordinary (zero-level) capabilities as those that permit a firm to 'make a living' in the short term, the dynamic capabilities as those that operate to extend, modify or create ordinary capabilities." An organizational capability is a high-level routine that is learned, highly patterned, repetitious, founded in part in tacit knowledge, and the specificity of objectives.

Therefore, the organizational variations in coupling patterns between routine elements can be reflected in a spectrum of routine-base structures – varying from fully decomposable (the routines are composed of distinct clusters of routine elements coupled together with no significant ties between clusters) through nearly decomposable (routine clusters are discernable but are connected through cross-clusters couplings) to non-decomposable (no routine clusters emerge, as the couplings are pervasively distributed).
In Yayavaram and Ahuja's (2008) empirical study, the authors show that a nearly decomposable knowledge base increases the usefulness of the inventions generated from it, as measured by patent citations, and also the knowledge base's malleability or capacity for change.

In Zollo et al. (2002), the authors applied the concept of interorganizational routines to the strategic alliance context and argued the interfirm coordination and cooperation routines

significantly impact the performance of collaborative agreements. The interorganizational routines are defined as stable patterns of interaction among two firms developed and refined in the course of repeated collaborations.

In Becker's (2005) summarized paper for some empirical literature, four operatioalization methods for recurrent interaction patterns were suggested:
Identify repeated sequences
Identify fixed condition-action rules
Identify task variety and analyzability
Identify content, process and sequence of recurrent interaction patterns

The Collective Nature of Team Members

Individual cognition includes information sensation, perception, attention, memory and reasoning. But the empirical micro-foundation research relevant the interactive pattern between the individual team members is still under-explored.

However, let us extrapolate these findings to the interactions within NPD teams. Assume the collective nature of the team is the aggregation of the action and cognition of its team members. Abell et al (2008) proposed to address the collective nature of the team as an averaging mechanism. The average mechanism conception implies that firms do not have the complete information to internalize the full micro-complexity of external effects due to bounded rationality, which is why resorting to some averaging procedure is necessary. An important function of firms is to simplify the micro-complex of individual external productivity effects by means of routines and standard operating procedures (Cyert and March, 1963).

A key assumption of the behavioral theory of the firm is that firms adjust their behavior in response to their experience rather than acting on their expectations of future states of the world. Cyert and March's (1963) basic relational concepts regarding behavioral theory of firm as the following:
Quasi-resolution of conflict – the coalition in an organization is a coalition of members having different personal goals. Members require some procedure for resolving conflicts, such as acceptable-level decision rules, sequential attention to goals, or both.
Uncertainty avoidance – Organizations typically try to avoid uncertainty. Firstly, organizations avoid the requirement that they correctly anticipate events in the distant future by using decision rules emphasizing short-run reactions to short-run feedback, rather than anticipation of long-run uncertain events. Second, organizations avoid the requirement that

they anticipate future reactions of other parts of their environment by arranging a negotiated environment. Organizations impose plans, standard operating procedures, industry tradition, and uncertainty-absorbing contracts on the environment.

Problemistic search – means search that is stimulated by a problem (usually a rather specific one) and is directed toward finding a solution to that problem. Such organizational search is assumed to be motivated, simple-minded, and biased. This bias may reflect training or experience of various parts of the organization. This bias may reflect the interaction of hopes and expectations, and communication biases are expected to reflect unresolved conflicts within the organization.

Organizational learning – to assume that organizations go through exactly the same processes as individuals go through seems unnecessarily naïve, but organizations exhibit(as do other social institutions) adaptive behavior over time. Cyert and March (1963) focus on adaptation with respect to three different phases of the decision process: adaptation of goals, adaptation in attention rules, and adaptation in search rules. Cyert and March submit that organizations change their goals, shift their attention, and revise their procedures for search as a function of their experience.

Team age/ Team tenure is not always positively impacting the performance. Pelz (1967) proposed the group specialization (prefer deep probing of narrow areas) will increase as the team age increases, on the other side, due to not-invented-here syndrome, the group generalization is downward as the time goes by. Most interesting is the overall team usefulness presenting a invert U-curve by reaching the peak at 4-5 years of team tenure. Therefore, the idea of bringing heterogeneity to product development is not new. One essential prerequisite for success with heterogeneous teams is that the coordination of the different and partial conflicting ways of perceiving the issues to be addressed can be realized on a constructive base.

Emden et al. (2006) conducted a narrative qualitative method to explore a process of partner selection for enhancing the advantage of NPD projects. The process of partner selection is divided into three phases: technological alignment, strategic alignment, and relational alignment.

NPD Performance

Overall product performance
Ultimate market performance

NPD performance not only rests on strategy, incentives and processes, but also on the

motivation of the professionals and the culture within which they are embedded.
Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation.

Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution (March, 1991:71).

Exploitation and exploration require fundamentally different organizational structures, strategies, and contexts. There is a trade-off between aligning the organization to exploit existing competencies and exploring new ones. Raisch and Birkinshaw (2008) review various literature streams to develop a comprehensive model that covers research into the antecedents, moderators, and outcomes of organizational ambidexterity.

The cross-functional teams allow both encouragement to take risk and quality orientation to operate simultaneously, positively affect the novelty and appropriateness of innovation, then increase the new product performance (Sethi and Sethi, 2009).

Environmental Uncertainty

Akgün et al. (2006) investigated 319 NPD teams, and argued that NPD performance will be achieved by unlearning the beliefs and routines against rigidity in the turbulent environment.

Time Pressure

Resource constraint
In Andrews and Farris' (1972) empirical study on scientists and engineers, this study showed a significant inverted U-curve relationship between time pressure and performance.

Based on the above literature review, we propose some propositions in this study are the following:
(1) *the higher level of cognitive heterogeneity will result in the higher sequential variety of interactive patterns and higher explorative performance under low time pressure and low environment uncertainty; on the other hand,*
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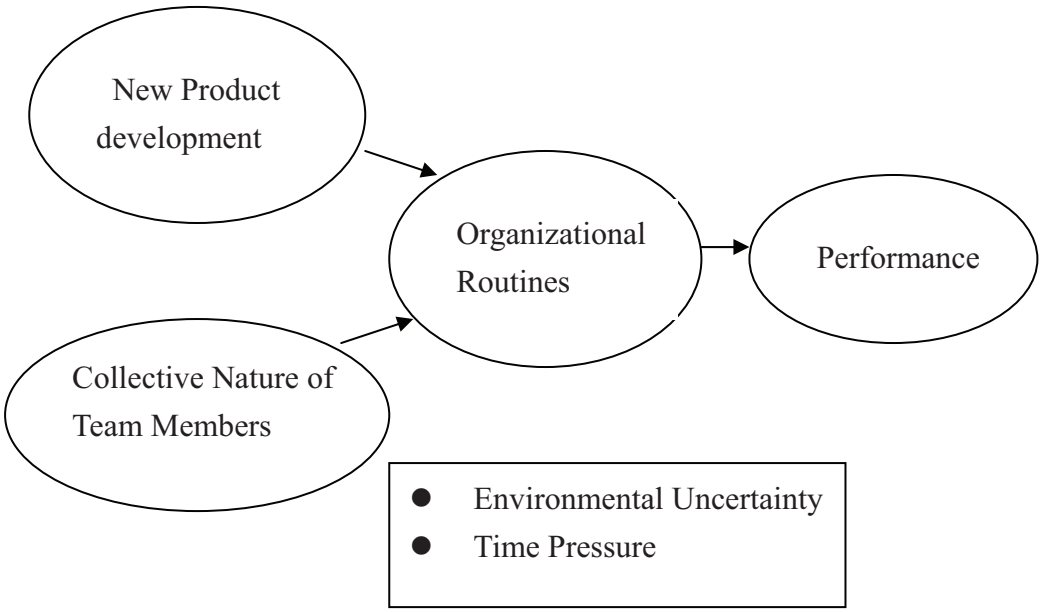

Figure 1. the relationship framework of this study

DISCUSSION

In the two decades since Nelson and Winter's publishing the seminal book titled *An Evolutionary Theory of Economic Change*, there has been an ever-increasing influence of the ideology of organizational routines on management field. We propose some implications for future theoretical research and for practical management.

Implications for Theoretical Research

Managerial behaviors and organizational outcomes increasingly are recognized to be the result of the interaction of multiple interdependent processes. Progress in understanding these phenomena depends partly on the ability to incorporate more complexity into management theory and to conduct research on the consequences of the resulting theory. Simulation is an increasingly significant methodological approach to theory development in the literature focused on strategy and organizations (e.g., Bruderer and Singh, 1996; Repenning, 2002; Rivkin and Siggelkow, 2003; Zott, 2003). Indeed, several influential research efforts (e.g., Cohen et al., 1972; March, 1991) have used simulation as their primary method. Recently, such methodology is also recommended on the heavyweight journal of the management field

(Davis et al., 2007; Harrison et al., 2007).

Simulation analysis offers a variety of benefits. It can be useful in developing theory and in guiding empirical work. It can provide insight into the operation of complex systems and can explore their behaviors. It can examine the consequences of theoretical arguments and assumptions, generate alternative explanations and hypotheses, and test the validity of explanations. Bt relying on formal modeling, simulation imposes theoretical rigor and promotes scientific progress.

This study will be focused to treat the team members as the agents in the simulation algorithm. Agent-based models – the behaviors of adaptive actors who make up a social system and who influence one another through their interactions; the behavior of the system is an emergent property of the interaction of the agents.

- How they interact to influence one another?
- The outcomes of interest typically are the consequences of the agent behaviors for the social system as a whole.

In Becker's (2005) summarized paper for some empirical literature, four operatioalization methods for recurrent interaction patterns were suggested:

Identify repeated sequences

Identify fixed condition-action rules

Identify task variety and analyzability

Identify content, process and sequence of recurrent interaction patterns

This study is focused on the level of project and team. Somehow, the organizational routines are positioned on higher macro level. Therefore, the fit between strategic typology (e.g., Miles and Snow, 1978: prospector, analyzer, and defender) and the type of organizational routines is interesting for future research.

Implications for Managerial Practice

The case of ASUS' Eee PC

Actually, no one practice was found to be either necessary or sufficient to guarantee that a firm was one of the best in developing new products due to the contextual factors.

Best NPD practices could be perceived as the 'public' routines and statistically more highly associated with the best included the following:

- The use of formal NPD processes.
- Having a specific NPD strategy.
- Measuring NPD outcomes and expecting more out of NPD efforts.

- Using cross-functional development teams.
- Using multiple different types of qualitative market research, including voice of the customer, customer visit, and beta-testing techniques.
- Using engineering design tools such as computer aided design (CAD) and computer simulations.
- Closing NPD projects with completion dinners.

On the organizational renewal issue, the problem experienced by established firms attempting to create new business is to focus attention on the forces that shape and constrain the development of new incentive systems. Therefore Kaplan and Henderson (2005) suggested that incentives and cognition coevolve so that organizational competencies or routines are as much about building knowledge of 'what should be rewarded' as they are about 'what should be done.'

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The Effects of Interactivity and Hedonic Value on WOM and Attitude towards the Website

Wann-Yih Wu, Cheng Kung University, Taiwan
wanyi@mail.ncku.edu.tw
Shu-Min Li, Cheng Kung University, Taiwan
ra796402@mail.ncku.edu.tw
Chia-Jung Chuang, Cheng Kung University, Taiwan
stella.ncku@gmail.com

ABSTRACT

With the growing of Internet users increasing, opportunities for online shopping continue to expand as well. More and more stores expand their business on the internet through websites and the e-commerce marketing activities have created considerable attention. Online users can not only extend their opinions for gathering product information from other consumers but also have the opportunity to offer their own consumption experiences by engaging in electronic word of mouth (eWOM) which is often regarded as one of the most important drivers to affect online consumers' attitude and buying decisions. However, users who accept the information online do not mean that they can recommend what they know. The purpose of this study is to evaluate the perceived interactivity and perceived hedonic value on the interrelationships among social gain, eWOM referral likelihood and attitude towards the website. The population is the average consumers who have ever used Internet to search WOM information. Several conclusions are made as follows: (1) the different level of perceived interactivity and perceived hedonic value has significant influence on social gain, and the higher perceptions of interactivity and hedonic value, the more significantly effects on the social gain; (2) the different level of perceived interactivity and perceived hedonic value has significant influence on electronic word of mouth referral likelihood and attitude towards the website; and (3) the different level of social gain has significant influence on electronic word of mouth referral likelihood and attitude towards the website.

Keywords: Perceived Interactivity, Perceived Hedonic Value, Social Gain, Electronic Word of Mouth Referral Likelihood and Attitude towards the Website

RESEARCH MOTIVATIONS AND OBJECTIVES

As the number of Internet users continues to increase, opportunities for online shopping continue to expand as well (Overby & Lee, 2006). According to Market Intelligence Center's (MIC) report, the B2C market has rapidly grown from 90 billion NT dollars in 2006 to 138.4 billion NT dollars in 2008. It revealed that internet users are getting more involved in the online purchasing behavior. However, it's hard to identify the complex products information offered online and recognize the sources to help online shoppers make their decisions.

Therefore, users are getting more used to search other online consumers' opinions for gathering unbiased product information as well as their own purchase experience. And these processes can all be viewed as a form of engaging in the Electronic Word of Mouth (eWOM) communication (Hennig-Thurau, Gwinner, Walsh, & Gremler, 2004). According to Godes and Mayzlin (2004), marketers are interested in eWOM because it is often an important driver of consumer attitude and behavior such as the adoption of new technology, product or brand, the decision to search for other related product information, etc. Hence, eWOM may as well serve a leading indicator of a product's success (Godes & Mayzlin, 2004). Particularly for online sellers, how to utilize and design the internet medium (e.g. website) to identify consumers need, attract more consumers, induce or motivate online consumers or browsers willingness to recommend (creating a eWOM) is very crucial to enhance selling.

The interactive nature of internet and web also offer many opportunities to increase the efficiency of online buying behavior (Coyle & Thorson, 2001). Interactivity is regarded as one of the important factors of website design (Wang, Baker, Wagner, & Wakefield, 2007) that significantly influences how individuals perceive and process websites**.** If the interactivity consumers perceived is high, it can be a bonus effect that the creation of an illusory interpersonal relationship with the individual behind the website as well as spreading the information from the website become feasible (Thorson & Rodgers, 2006).

On the other hand, for many browsers, the hedonic experiences may not be an end in itself; they enjoy the hedonic process instead of the actual buying behavior. Eroglu et al. (2003) found that hedonic dimension (both pleasure and arousal) had significant positive effects on approach responses towards the site. Shopping pleasure was associated with an increase in one's willingness to share shopping experiences (Paridon, 2004). Both of these two variables may serve as the accelerator to promote the eWOM spreading.

In addition, people are normally not willing to talk about the information online or recommend to other website users automatically unless some factors motivated. It is

important to realize the social and psychological way to discuss the potential incentive to induce them to be willing to make a referral. Because the emergence of the virtual community has shifted the social benefits from friends and relatives to friends known through the Internet (Wolfinbarger & Gilly, 2001), many people are getting more treasuring on their social network online (Arnold & Reynolds, 2003).

Based on the above discussion, the purposes of this study are three folds: (1) to identify the constructs of perceived interactivity, perceived hedonic value, social gain (social benefit, social cost and psychological cost), eWOM referral likelihood, and attitude towards the website in consumer-related marketing; (2) to investigate the effects of perceived interactivity and perceived hedonic value on social gain (social benefit, social cost and psychological cost), eWOM referral likelihood and attitude towards website; and (3) to investigate the effects of social gain and eWOM referral likelihood on attitude towards website.

LITERATURE REVIEW

Interrelationships between Perceived Interactivity, Perceived hedonic value, and Attitude toward Website

Liu et al. (2002) suggested that interactivity was a multidimensional construct that consists of active control, two-way communication, and immediate feedback. Wolfinbarger and Gilly (2001) argued that interactivity can provide immediate responses and feedback from the website, facilitates products information collecting and sharing, and has the power to control the using way, etc. Scholars have demonstrated that interactivity was a crucial factor positively affecting both consumers' comprehension of interactive advertising (Macias, 2003b) and the attitude (Fiore & Jin, 2003; Haseman, Nuipolatoglu, & Ramamurthy, 2002; Raney, Laura M., Pashupati, & Brill, 2003). Compare to the actual interactivity, studies have revealed that perception-based model is more suitable to predict consumers' attitude (Wu, 1999; Lee, 2000; McMillan & Hwang, 2002). Thorson and Rodgers (2006) stated that actual interactivity and perceived interactivity did both positively impact the online browsers' attitude toward the blogs. Furthermore, the perceived interactivity has more significantly influences on the attitude toward the website. This finding was consisting with Schlosser et al. (2003) and Yoo and Stout (2001). It showed that the higher perception of interactivity, the greater influences on consumers' attitude toward the website.

On the other hand, Kim and Morris (2007) pointed out that consumers perceived higher levels of hedonic and experiential messages from the online website will create higher levels of affective responses. For those customers purchasing online, the hedonic experiences may

not be an end in itself, but may influence their behavioral responses. Many studies suggested that consumers would bring the atmospheres of online shopping environment in to consideration. The more of the immersive, hedonic aspects of the new media especially showed their crucial predictors of online attitudes (Eroglu et al., 2003; Fiore et al., 2005; Childers et al., 2001; Voss et al., 203). Thus, this study combines above two dimensions (perceived interactivity and perceived hedonic value) and proposes the hypothesis as follows:

H1: Online users who perceived higher interactivity and higher hedonic value will positively influence the level of attitude toward website.

Interrelationships between Perceived Interactivity and Perceived Hedonic Value on Social Gain

Interactivity can induce the social-related activities happened. Steuer and Nass (1993) suggested that interactivity was one of the critical cues particularly relevant to conducing social responses. Social response can occur in human–computer interaction (Moon, 2000) or in human–human interactions which have also been found to occur in computer–human interactions (Wang et al., 2007). Online visitors will have a trend to responses if these critical cues are high. Therefore, if two-way communication between visitors and the website, or the multidimensional communication with other internet users is high, online visitors are more willing to response and interact with other users (Moon, 2000) and the social relationship is easier built during the process of information transmitting process because higher perceived interactivity fills an emotional need to immediate interact with other users and get feedback (Dichter, 1966). Social benefit will be generated by developing good relationship with others.

On the other hand, the natures of interactivity can increase shopping efficiency by improving the availability of product information, enabling direct multi-attribute comparisons, and reducing information-search costs (Alba et al., 1997). Abundant information from the website or other users offers enough information to help them make the buying decision (Coyle & Thorson, 2001). Therefore, individuals would like to make a referral because social benefit has been attributed to expressing his (her) concerns or helping friends make a better decision. Thus, we might infer that a higher perception of interactivity will increase the social gain by enhancing the social benefits and reduce the sociopsychological costs.

From the perspective of hedonic value, Shim and Eastlick (1998) reported that the shopping experience of pleasant atmosphere (hedonic value) is one attribute involved in the relationship. Jason and Ann (2005) revealed that hedonic benefits reflected the emotional and psychological values (Babin et al., 1994) and are experiential and emotional in nature.

Therefore, online shoppers may enjoy the shopping process (To et al., 2007).

According to Paridon (2004), increasing shopping pleasure is associated with an increase in one's willingness to share shopping experiences. Based on the concepts above, we infer that online users who have perceived higher hedonic value will have higher social benefit. Thus, concluding above discussions, this study proposes the hypothesis as follows:
H2: The level of perceived interactivity and perceived hedonic value will impact on the level of social gain.

Interrelationships between Perceived Interactivity and Perceived Hedonic Value on eWOM Referral Likelihood

The presence of an interactive feature, such as a hyperlink that enables users to post messages, influence how individuals perceive and process the websites (Thorson & Rodgers, 2006). Sharing their viewpoints and engaging with their constituents is regarded as a form of eWOM in the website. According to Brown (2006), interactivity creates a depth of involvement which leads to some astounding behavioral and attitudinal effects, including the generation of significant online word of mouth.

In addition, people who enjoy or otherwise find the shopping experiences enjoyable will share that experience with their friends. In the study of Paridon (2004), opinions exchange was characterized primarily by the transmission of hedonic-related information. Interpersonal influences between friends can be described as give and take behaviors (Paridon, 2004). Shopping in a pleasurable environment was associated with an increase in one's willingness to share shopping experiences. It seems that the perceived hedonic value lets browsers involved in the hedonic situation have the tendency to increase the possibility to share their information. Thus, online participants who perceived high hedonic value increase the eWOM referral likelihood (Paridon, 2005). Based on the discussions above, this study proposes the hypothesis as follows:
H3: The level of perceived interactivity and perceived hedonic value will impact on the level of electronic word of mouth referral likelihood.

Interrelationships between Social Gain and eWOM Referral Likelihood

Several scholars have adopted the concept of exchange theory to discuss consumers' responses in relation to referral reward program. Their study results revealed that the customers' decision about whether to be involved in WOM might depend on the perceived costs and benefits of the exchange (Gatignon & Robertson, 1986; Walster, Walster,

Berscheid, & Austin, 1978). Moreover, in the experiments of Frenzen and Nakamoto (1993), they explored the willingness of customers to transmit market information acquired firsthand in a social exchange perspective. This finding showed that the interplay of individuals and their social context is important in regulating the spread of WOM information (Frenzen & Nakamoto, 1993). In addition, researchers commend that customers may derive both social and economic value from participating in eWOM (Balasubramanian & Mahajan, 2001). The benefits or rewards refers to worthwhile or valuable outcomes to the participants in the relationship (Nielson, 1998). Therefore, this study infers that the greater social benefits that people perceive might cause more tendencies to participate eWOM.

Furthermore, when people want to give some information to others, costs may prohibit online users from recommending WOM (Gatignon and Robertson 1986). There is also a risk of offering inappropriate advice to other users, which may hurt the relationship between providers and receivers (social cost). And this may hurt providers' self-esteem (Schneider & Bowen, 1999) as well as create the feeling of anxiety (Gwinner & Gremler, 2000) and uncomfort (psychological cost). These (social and psychological) costs can all inhibit the possibility of website visitors from making a referral. Conversely, if online browsers perceived low level of these costs, it may positively enhance the eWOM referral likelihood. Thus, concluded and based on the discussions above, this study proposes the hypothesis as follows:

H4: The level of social gain will significantly impact on the level of electronic word of mouth referral likelihood.

Interrelationships between Social Gain and Attitude toward the Website

According to Shim and Eastlick (1998), shoppers who place stronger emphasis on self actualization (self-fulfillment, sense of accomplishment and self-respect) and social affiliation (friendly relationship) values are more likely to have a favorable attitude toward shopping behavior. The greater social affiliation may develop more friendly relationships with others and can be regarded as a kind of social benefit. Since social affiliation plays a critical role on mall shopping attitude, it may shed some light on researches to not only focus on the purchasing behavior but also on the search of socializing benefits (Feinberg, Meoli, & Rummel, 1989) and recreational opportunities (Roy, 1994). Therefore, positive social gain might lead to a favorable attitude towards the website. Conversely, lower social and psychological costs will also positively influence the attitude toward the website. Therefore, we conclude the discussions above and propose the hypothesis as follows:

H5: The level of social gain will positively influence the level of consumers' attitude toward the website.

Interrelationships between eWOM and Attitude toward the Website

Word-of-mouth (WOM) is regarded as the most believable form of advertising for marketers (Henricks, 1998). Several scholars revealed that WOM has long been recognized as an important force in the marketplace and influence consumers' attitudes (Bone, 1995) and decision making (Bansal & Voyer, 2000; Wangenheim & Bayón, 2004). Wangenheim (2005) pointed out that the WOM shaped consumers' attitude and purchase behavior. According to Wangenheim and Bayón (2007), Electronic WOM works through attitude changes in consumer behavior research. For example, experimental studies showed that referrals positively influence consumer attitudes of goods and services (Bone, 1995; Herr, Kardes, & Kim, 1991), which in turn increase the likelihood of the purchasing behavior. Receiving word-of-mouth also influences the receivers' awareness, attitudes, product evaluations, intentions, and expectations (Butler & Peppard, 1998; Gelb & Johnson, 1995). Therefore, based on the discussions above, this study proposes the hypothesis as follows:
H6: The level of electronic word of mouth referral likelihood will positively influence the level of consumers' attitude toward the website

RESEARCH DESIGN AND METHODOLOGY

Research Model

Based on the above literature review, this study develops a research model as shown in Figure 1. It is suggested that, perceived interactivity and perceived hedonic value will directly impact consumers' attitude toward website. Besides, different degrees of perceived interactivity and perceived hedonic value will impact social gain (social benefit, social cost and psychological cost) and also influence the eWOM referral likelihood. Finally, the social gain and eWOM referral likelihood will affect consumers' attitude towards the website.

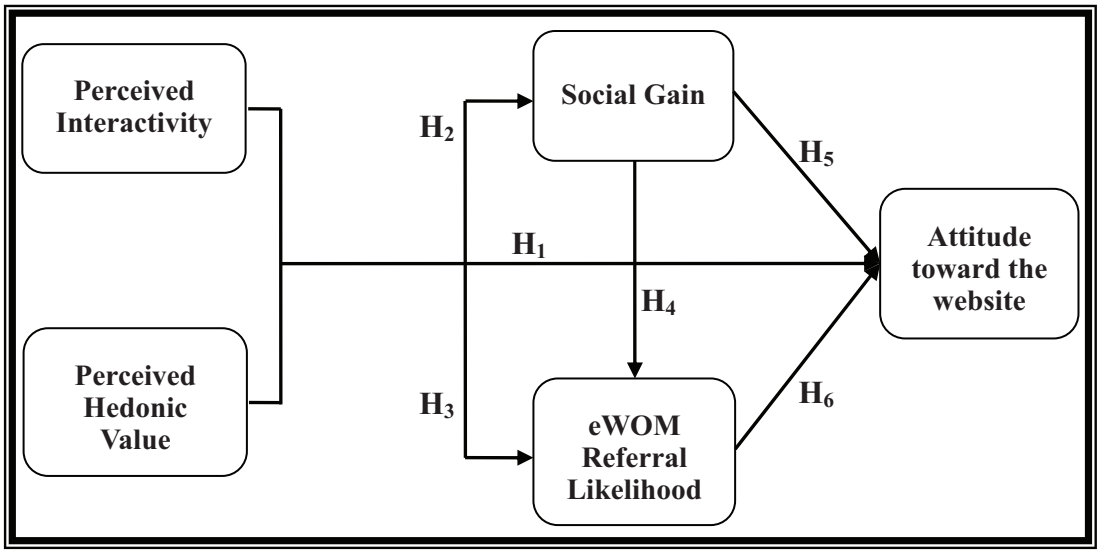


Figure 1 The Research Model of This Study

Experimental Design and Stimuli

Four conditions derived from the 2 (higher or lower perceived interactivity) x 2 (higher or lower perceived hedonic value) between subjects factorial design will be implemented, as depicted in Table 1. The study has two independent variables with two levels each. Social gain, electronic word of mouth referral likelihood and attitude towards the website are examined as the dependent measures. Participants were randomly assigned to one of the four treatment groups. The following is a list of variables manipulated and measured in the study.

Table 1 Diagrammatic representation of the study design with the independent variables

		Perceived Interactivity	
		High	Low
Perceived hedonic value	High	I	II
	Low	V	VI

The websites used in this study is book-related websites. The reason why choose book-related products account for the largest online catalogues in Taiwan (ITST, 2007). Although the sales of cosmetics product is the most, however, owing to the participants' preferences, we consider book-related websites is more suitable in this study. Due to the difficulties designing our own pseudo-websites, this study will select eight existing book-related websites (each kind of catalog was assigned two websites). The selection of book-related websites will be

based on the result of a pilot study. In the pilot study, respondents are asked to look at one of the websites and then answer the questionnaire items related to perceived interactivity and perceived hedonic value. Those website that do not fit into the above four categories are considered as not qualified and thus will be deleted from further consideration.

Sampling Design and Procedure

The subjects are the individuals who have internet usage experiences, and are used to searching information online. Individuals were randomly assigned to browse one of these websites and ask the Internet consumers to answer in the Internet questionnaire. After respondents have completed the first three parts of the questionnaire (perceived interactivity, perceived hedonic value and brand strength), they were asked to imagine a "target individual" whom they want to share the information of this website with and answer the following questions. The "target individual" should be one person that the subjects can make a referral to online. The study is conducted on the Internet by posting the message in the Bulletin Board System.

The pretest was conducted to confirm our manipulation of the four types of websites (I~ VI). Subjects are asked to complete the first two sections (perceived interactivity and perceived hedonic value) of the questionnaire after browsing twenty websites this study has chosen online. After the pilot test, eight websites of twenty websites were chosen and each catalog will be assigned two websites. Besides, the questionnaire items are refined through a process of purification. In the formal test, subjects will be selected from website browsers, and are those who have internet usage.

Construct Measurement and Questionnaire Design

In this study, seven major sections were operationalized: (1) perceived interactivity, (2) perceived hedonic value, (3) social gain, (4) eWOM referral likelihood, and (5) attitude towards the website.

Table 2 The Questionnaire Items

Construct / Dimension / Item	**Reference**
Perceived interactivity	
Part I: Perceived Control (PC)	
1. I was in control of my navigation through this Web site.	Wu (2006)
2. I had some control over the content of this Web site that I wanted to see.	
3. I was in total control over the pace of my visit to this Web site.	

Part II: Perceived Responsiveness (PR)	
4. I could communicate with this website directly for further questions about this website or its products if I wanted to. 5. This website had the ability to respond to my specific questions quickly and efficiently. 6. I could communicate in real time with other customers who shared my interest in this website.	Wu (2006)
Part III: Perceived Personalization (PP)	
7. I felt I just had a personal conversation with a sociable, knowledgeable and warm representative from this website. 8. This website seemed like it was talking back to me while I clicked through the website. 9. I perceived this website to be sensitive to my needs for product information.	Wu (2006)
Perceived hedonic value	
1. I love this website. 2. I feel good when I use this website. 3. Browsing the website is truly a joy. 4. Compared to other things I could have done, the time spent browsing this website is truly enjoyable. 5. During browsing this website, I felt the excitement of the hunt.	Wee et al. (1995)
Social Gain	
Part I : Social benefit (SB)	
1. I want to share the information (experiences) of the website to help others make better choices. 2. I want to share my information (experiences) to develop a good relationship with others. 3. I want to share my information (experiences) of this website to express genuine concern. 4. In my perception, sharing information (experiences) is like giving others a thoughtful gift. 5. Providing the information of this website can increase my social status.	Chaudhuri and Holbrook (2002) and Ryu and Feick (2007)
Part II : Social cost (SC)	
1. I want to share the information of this website because I feel responses from other users in this website. 2. I want to share the information of this website because it does not take much time to communicate with other users. 3. I think the information of this website is appropriate to provide to other users. 4. Providing advice about this website to my friend will improve the relationship with my friends.	Folkes (1984), Dichter (1996) and Gatignon and Robertson (1986)
Part III: Psychological cost (PYC)	

1. Providing advice about this website information will let me have a feeling of anxiety and lower my self-confidence. 2. Providing advice about this website might be considered motivated by the possibility of increasing status. 3. I do not want to share the information of this website to avoid being considered as a flaunty person. 4. I do not want to share the information of this website to avoid being considered motivated by economic benefits. 5. The feeling of being selfish due to motivating by economic benefits might prohibit me from make a referral to other users.	Schneider and Bowen (1999), Gwinner and Gremler (2000) and Ryu and Feick (2007)
Electronic WOM referral likelihood	
1. I say positive things about this website to other people. 2. I recommend this website to anyone who seeks my advice. 3. I want to share the information of this website to other users. 4. I do not encourage friends to do business with this website.	Zeithaml et al. (1996) and Srinivasan et al. (2002)
Attitude toward website	
1. I will visit this website again 2. This site is helpful 3. This site is entertaining 4. The content of this site is very rich 5. This site is really deferent	Müller and Chandon (2003)

Note: All the items will be measured on a seven-point Likert scale, 1= the item is "the lowest agreeable level of agreement", and 7 represents that this item is "the highest agreeable level of agreement").

DESCRIPTIVE ANALYSIS AND RELIABILITY TESTS

Characteristics of Respondents

The data were gathered through Internet questionnaire survey over half a month period, including two pilot tests and one final survey. The survey was conducted on the internet (www.my3q.com). Besides, respondents were randomly assigned to browse one of the eight websites and then asked to express their opinions based on the website. For the final survey, a total of 315 survey questionnaires were collected. There were 14 ineffective or missing data among the 315 questionnaires. In addition, we used inverse questions to verify the logic of questionnaires and drop off 61 invalid questionnaires. Therefore, 240 questionnaires were usable to go with the following analysis.

The basic attributes of the respondents in this study include eight major items: (1) gender, (2) age, (3) education, (4) monthly income, (5) occupation, (6) hours of using the Internet on a typical day, (7) viewing time of this Website, and (8) online purchasing Experiences.

It is shown that more than 58% of respondents are male. More than 77% of the respondents

are less than 25 years old. More than 65% of the respondents possess a college degree. More than 72% of the respondents earn less than 10 thousands per month. About 79% of the respondents are students. More than 62% of the respondents use the Internet more than 4 hours on a typical day. About 50% of the respondents view the website over 5 minutes. And more than 82% of the respondents have online purchasing experiences.

Reliability Tests

To verify the dimensionality and reliability of the research constructs, purification processes, including factor analysis, item-to-total correlation and internal consistency analysis (Cronbach's alpha) were conducted in this study. For each research construct, factor analysis was first employed to identify the dimensionality of the construct, to select questionnaire items with high factor loadings (>0.6), and to compare these selected items with items suggested theoretically. Item-to-total correlation (>0.5), coefficient alpha (>0.7) are then assessed to identify the internal consistency and reliability of the construct. As shown in Table 3, the results of factor analysis, item-to-total correlation and internal consistency analysis for the research variables are all confirmed to be reliable.

Table 3 Factor and Reliability Analysis

Factor	Factor Loading	Item to Total Correlation	Eigen-values	Cronbach's α
Perceived Control (PC)	0.847~0.891	0.666~0.736	2.272	0.840
Perceived Responsiveness (PR)	0.772~0.862	0.517~0.650	2.009	0.752
Perceived Personalization (PP)	0.827~0.889	0.615~0.723	2.163	0.806
Perceived Hedonic Value (PHV)	0.826~0.936	0.741~0.891	3.963	0.934
Brand Strength (BS)	0.746~0.902	0.587~0.805	2.835	0.861
Tie Strength (TS)	0.853~0.894	0.736~0.807	3.073	0.899
Social Benefit (SB)	0.836~0.889	0.713~0.790	3.034	0.894
Social Cost (SC)	0.824	0.358	1.350	0.527
Psychological Cost (PYC)	0.853~0.880	0.674~0.720	2.264	0.837
Electronic Word of Mouth Referral Likelihood	0.884~0.928	0.744~0.828	2.442	0.885
Attitude toward the website	0.863~0.902	0.754~0.821	3.106	0.904

Manipulation Check

To check the validity of source credibility manipulation, this study asked subjects to answer 8 items about perceived interactivity and perceived hedonic value on a seven-point rating scale. Again, a composite score is derived and used for analysis. The results of the message manipulation are shown in Table 4, showing significant effects for perceived interactivity ($t=9.048$, $p<0.001$) and perceived hedonic value ($t=-13.117$, $p<0.001$), indicating that manipulations are effective for the study.

Table 4 Manipulation Check for Attitude toward the website

	HH[a]	LL[b]	t	p
Perceived Interactivity	4.5963	3.711	9.048	0.0000
Perceived hedonic value	4.9667	3.170	13.117	0.0000

*a: HH is the group of high perceived interactivity and high perceived hedonic value

*b: LL is the group of low perceived interactivity and low perceived hedonic value

RESEARCH ANALYSIS AND RESULTS

To test H1, ANOVA method is conducted on full sample data. In this model, attitude toward the website is treated as the dependent variable. The research variable of the perceived interactivity and perceived hedonic value is added. The results of ANOVA are shown in Table 5, Table 6 and Figure 2.

Table 5 Main Effect and Interactive Effect Test of Hypothesis 1

Source of Variance	***SS***	***DF***	***MS***	***F***	***P-Value***
Perceived Interactivity	11.432	11.000	1.039	2.357	0.011**
Perceived Hedonic Value	101.325	27.000	3.753	8.511	0.000***
Perceived Interactivity × Perceived Hedonic Value	38.104	72.000	0.529	1.200	0.184

Note: 1. *** represents that the coefficients are significant at 0.01 or above,
2. ** represents that the coefficients are significant at 0.05 or above,
3. * represents that the coefficients are significant at 0.1 or above,

As Table 5 shows, the main effects of perceived interactivity and perceived hedonic value on attitude toward the website are both significant ($F=2.357$, $P<0.05$; $F=8.511$, $P<0.000$). It means that the two measuring variables have direct influences on attitude toward the website. However, the interactive effects between perceived interactivity and perceived hedonic value are not statistically significant ($F=1.200$, $P=0.184$).

Besides, Table 6 reveals that F- value is 35.861 and P-value is less than 0.001. The significant sign indicates that the different degree of perceived interactivity and perceived hedonic value will lead to the difference of attitude toward the website. In addition, Table 6 and Figure 2 also indicate the difference in average that the more interactivity-hedonic perceptions lead to higher level of attitude toward the website. Therefore, H1 of this study is supported.

Table 6 ANOVA Analysis Results for Hypothesis 1

	HH[a] 1 (n=60)	**HL[b] 2 (n=60)**	**LH[c] 3 (n=60)**	**LL[d] 4 (n=60)**	**F-value**	**P-value**	**Duncan**
Attitude toward the	5.3167	4.6000	4.4625	3.5208	35.8610	0.000**	(3,24,1)

website							

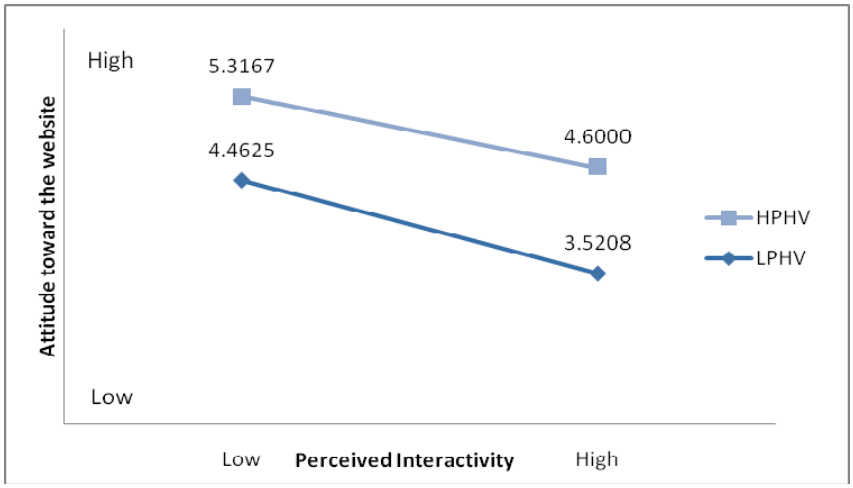
Note: 1.** represents P<0.01

2.a: HH is the group of high perceived interactivity and high perceived hedonic value

3.b: LL is the group of high perceived interactivity and low perceived hedonic value

4.c: LL is the group of low perceived interactivity and high perceived hedonic value

5.d: LL is the group of low perceived interactivity and low perceived hedonic value



Note: 1. HPHV represents the high perceived hedonic value

2. LPHV represents the low perceived hedonic value

Figure 2 the Interrelationship among Perceived Interactivity and Perceived Hedonic Value to attitude toward the website

The result shown above reveals that H1 is supported and fits our expectation. It's identical with the study of previous studies that the higher perception of interactivity (Schlosser et al., 2003; Yoo and Stout, 2001) and higher perception of hedonic value (Eroglu et al., 2003), the greater influences on consumers' attitude toward the website. Furthermore, in accordance with the studies of perceived interactivity (Thorson and Rodgers, 2006) and hedonic value (Fiore et al., 2005), they prove the more ratio of interactivity and hedonic information perceived from the online stores, the more positive attitude consumers will have. Therefore, the H1 is supported.

Interrelationship among Perceived Interactivity, Perceived Hedonic Value and Social Gain.

To test H2, the method of multivariate analysis of variance is conducted on full sample data. In this model, the two factors of social gain (social benefit and psychological cost) are treated as the dependent variables. The research variable of the perceived interactivity and perceived hedonic value is added. The results of MNOVA are shown in Table 7, Table 8 and Figure 3.

As Table 7 shows, the main effects of perceived interactivity and perceived hedonic value on attitude toward the website are both significant (F=1.685, P<0.1; F=4.272, P<0.000). It means that the two measuring variables have direct influences on social gain. Furthermore, the interactive effects between perceived interactivity and perceived hedonic value are also statistically significant (F=1.564, P<0.05).

Table 8 reveals that F-value of social benefit is 9.13, and P-value is less than 0.001. In addition, F-value of psychological cost is 8.021 and P-value is less than 0.001. The significant sign indicates that the different degree of perceived interactivity and perceived hedonic value will lead to the difference of social benefit and psychological cost (the measuring items of psychological cost have been reversed, therefore, the higher score of psychological cost means respondents have lower perceptions of psychological cost). Besides, Table 8 and Figure 3 also indicates the difference in average that the more interactivity-hedonic perceptions lead to higher level of social benefit. That is to say higher perceived interactivity can induce users easier to develop good relationship, get feedback, and interact with other users, just as Dichter (1996) and Shim and Eastlick (1998) mentioned.

On the other hand, Figure 4 shows that the more interactivity-hedonic perceptions will lead to lower level of psychological cost. The result is consistent with the study of Ryu and Feick (2007). They pointed out that higher interactivity can offer product information efficiently (Alba et al., 1997) and reduce the feeling of been considered as selfish person who talking about the website to others is motivated by economic benefits. Hence, the H2 of this study is supported.

Table 7 Main Effect and Interactive Effect Test of Hypothesis 2

Source of Variance	*SS*	*DF*	*MS*	*F*	*P-Value*
Perceived Interactivity	9.266	16.000	0.579	1.685	0.062*
Perceived Hedonic Value	40.583	27.000	1.503	4.373	0.000***
Perceived Interactivity × Perceived Hedonic Value	51.586	96.000	0.537	1.564	0.014**

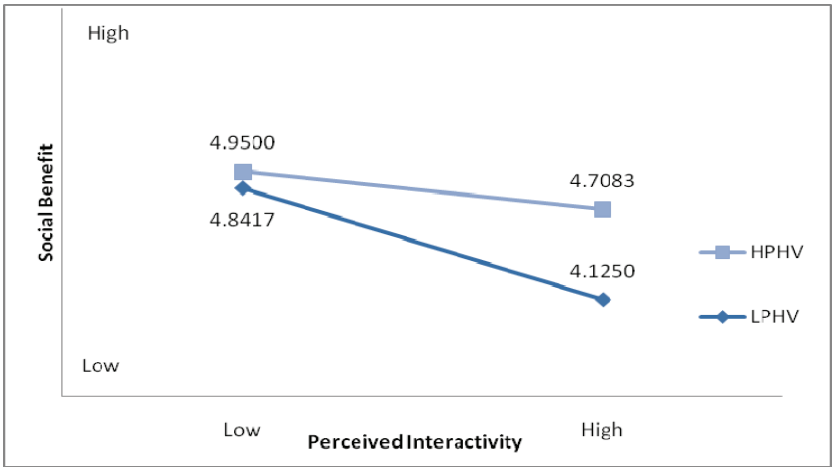
Note: 1. *** represents that the coefficients are significant at 0.01 or above,
2. ** represents that the coefficients are significant at 0.05 or above,
3. * represents that the coefficients are significant at 0.1 or above,

Table 8 MANOVA Analysis Results for Hypothesis 2

	HH[a] 1 (n=60)	HL[b] 2 (n=60)	LH[c] 3 (n=60)	LL[d] 4 (n=60)	F-value	P-value	Duncan
Social Benefit	4.950	4.8417	4.7083	4.125	9.130	0.000**	(324,1)
Psychological Cost	5.4167	5.0667	4.9278	4.4667	8.021	0.000**	(3,24,1)

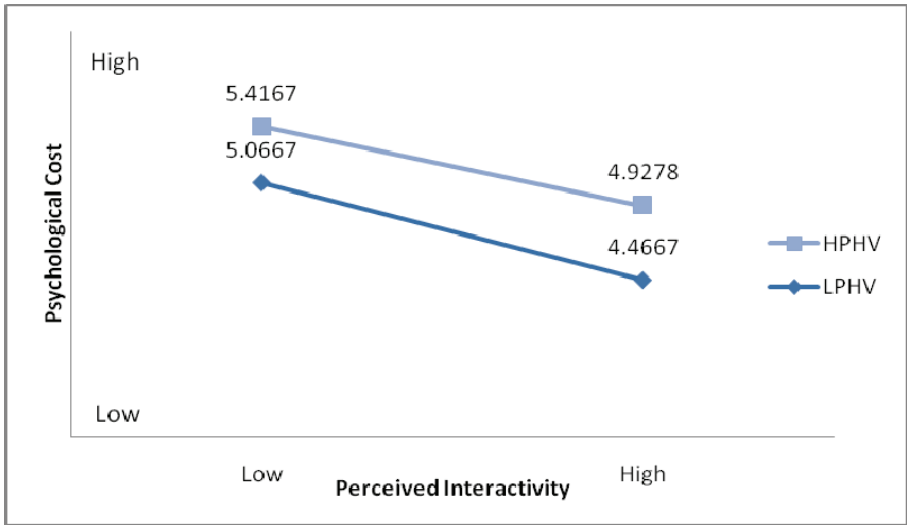
Note:1. ** represents P<0.01

2. a: HH is the group of high perceived interactivity and high perceived hedonic value
3. b: LL is the group of high perceived interactivity and low perceived hedonic value
4. c: LL is the group of low perceived interactivity and high perceived hedonic value
5. d: LL is the group of low perceived interactivity and low perceived hedonic value



Note: 1. HPHV represents the high perceived hedonic value
2. LPHV represents the low perceived hedonic value

Figure 3 the Interrelationship among Perceived Interactivity and Perceived Hedonic Value to Social Benefit of Social Gain



Note: 1. HPHV represents the high perceived hedonic value
2. LPHV represents the low perceived hedonic value

Figure 4 the Interrelationship among Perceived Interactivity and Perceived Hedonic Value to Psychological Cost of Social Gain

Interrelationship among Perceived Interactivity, Perceived Hedonic Value and Electronic Word of Mouth Referral Likelihood.

To test H3, one way ANOVA is conducted on full sample data. In this model, electronic

word of mouth referral likelihood is treated as the dependent variable. The research variable of the perceived interactivity and perceived hedonic value is added. The results of MANOVA are shown in Table 9, Table 10 and Figure 5.

As Table 9 shows, the main effects of perceived interactivity and perceived hedonic value on electronic word of mouth referral likelihood are both significant (F=2.263, P<0.01; F=5.255, P<0.000). It means that the two measuring variables have direct influences on electronic word of mouth referral likelihood. Furthermore, the interactive effects between perceived interactivity and perceived hedonic value are also statistically significant (F=1.857, P<0.001). Table 10 reveals that F-value is 16.155 and P-value is less than 0.001. The significant sign indicates that the different degree of perceived interactivity and perceived hedonic value will lead to the difference of electronic word of mouth referral likelihood. In addition, Table 10 and Figure 5 also indicate the difference in average that the more interactivity-hedonic perceptions lead to higher level of electronic word of mouth referral likelihood.

Table 9 Main Effect and Interactive Effect Test of Hypothesis 3

Source of Variance	*SS*	*DF*	*MS*	*F*	*P-Value*
Perceived Interactivity	15.071	16.000	0.942	2.263	0.007***
Perceived Hedonic Value	59.067	27.000	2.188	5.255	0.000***
Perceived Interactivity × Perceived Hedonic Value	74.197	96.000	0.773	1.857	0.001***

Note: 1. *** represents that the coefficients are significant at 0.01 or above,
2. ** represents that the coefficients are significant at 0.05 or above,
3. * represents that the coefficients are significant at 0.1 or above,

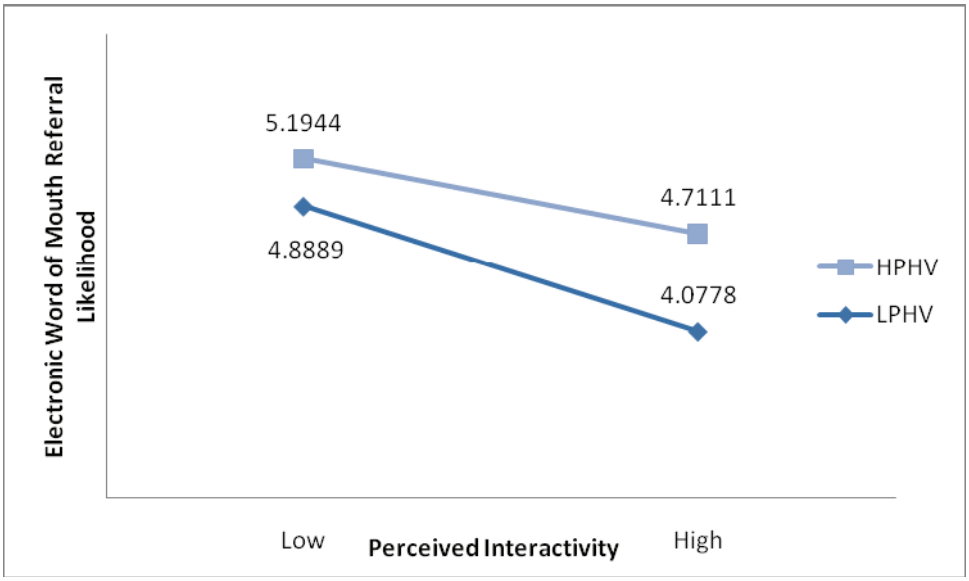
The result is consistent with previous studies that higher perceived interactivity and perceived hedonic value can create a more depth of involvement which induce the generation of word of mouth online (Paridon, 2005; Brown, 2006). Therefore, H3 is supported.

Table 10 ANOVA Analysis Results for Hypothesis 3

	HH[a] 1 (n=60)	HL[b] 2 (n=60)	LH[c] 3 (n=60)	LL[d] 4 (n=60)	F-value	P-value	Duncan
WOMF	5.1944	4.8889	4.7111	4.0778	16.155	0.000**	(3,24,1)

Note: 1. ** represents P<0.01
2. a: HH is the group of high perceived interactivity and high perceived hedonic value
3. b: LL is the group of high perceived interactivity and low perceived hedonic value
4. c: LL is the group of low perceived interactivity and high perceived hedonic value

5. d: LL is the group of low perceived interactivity and low perceived hedonic value



Note: 1. HPHV represents the high perceived hedonic value
2. LPHV represents the low perceived hedonic value

Figure 5 the Interrelationship among Perceived Interactivity and Perceived Hedonic Value to Electronic Word of Mouth Referral Likelihood

CONCLUSIONS AND SUGGESTIONS

Research Conclusions

The major objective of this study is to investigate the interrelationships among the perceived interactivity, perceived hedonic value, social gain, electronic word of mouth referral likelihood and attitude toward the website. Besides, the study also investigates the moderating effects of tie strength and brand strength on the relationships between the *perceived interactivity/perceived hedonic value* and three dependent variables (social gain, electronic word of mouth referral likelihood and attitude toward the website). Based on the results of this study, several conclusions could be drawn.

The first conclusion is that there are significant relationships between perceived interactivity-hedonic dimension and attitude toward the website. It is indicated that perceived interactivity (perceived control, perceived responsiveness and perceived personalization) and perceived hedonic value appear to impact on the attitude toward the website significantly. This result is consistent with Schlosser et al. (2003) and Fiore et al. (2005). That is to say, the perceptions of higher interactive-hedonic value will have positively attitude toward the website.

The second conclusion that can be drawn in this research is that the relationships between perceived interactivity-hedonic dimension and social gain. It means that online participants who have higher interactivity-hedonic perceptions tend to perceived higher social gain (higher social benefit and lower psychological cost). The influences between interactivity-hedonic on social gain is influential since participants' involving in high interactive-hedonic environment will induce their pleasure and can easier share the moods to establish good relationships with other online users (Dichter, 1966). In addition, the feeling of lower sociopsychological costs is also increasing the positive perceptions of social gain.

The third conclusion that can be drawn in this research is that there are significant relationships between perceived interactivity-hedonic dimension and electronic word of mouth referral likelihood. That is to say the perceived interactivity and perceived hedonic value creates a depth of involvement which lead to some astounding behavioral and attitudinal effects, including the generation of significant word of mouth online. The result is consistent with Thorson & Rodgers (2006).

The fourth conclusion that can be drawn in this research is that there are significant relationships among social gain, electronic word of mouth referral likelihood and attitude toward the website. Consumers with higher social gain tend to have higher likelihood of recommendation to others as well as their attitude toward the website. This result is consistent with Paridon (2006) and Wu (2006). Hence, a positive interactive-hedonic experience will act through consumer social gain contributes to one's willingness to engage in word of mouth spreading online (Paridon, 2005b) and also generate positive attitude toward the website.

Several managerial implications can be inferred from the above conclusions. First, among the three components of interactivity: control, responsiveness and personalization, advertisers can enhance the responsiveness among its target customers to determine whether more or less advanced website design or functions could be improved. Companies can also adopt some activities to make their target customers the opportunities to interact with other online users (Thorson and Rodgers, 2006). As they have considered these factors, companies are able to personalize navigation and advice while reducing complex menu bars or enable users to choose from a range of navigation styles (Bart, Shankar, & Urban, 2005).

Second, marketers can also enhance hedonic values through different mechanisms. For instance, marketers may question how to enhance the feelings of fun, excitement, and enjoyment perceptions? And how do specific cues, such as structural design attributes, media and store logo affect cognitive and behavioral responses of online users to the website

(Childers et al., 2001)? Then they can identify which hedonic activities can motivate their customers. By factoring in consumer's needs and requirements, perceived interactivity and perceived hedonic value can be manipulated to web advertiser's advantage.

Third, the concept of social gain is proved to have has significant influences on the electronic word of mouth recommendation. It shows that online shoppers not only take the economic benefits as the only key factors to cause them sharing product information of website, the social or psychological considerations behind consumers are also matter. Especially, online users' social benefits are often generated from the need to do something in order to link to their communities. Companies may be able to start monitoring online communities of their customers as a source of feedback, particularly on those members who typically provide comments and information. Companies can also filter community messages to modify the content of online websites to enhance persuasion, marketers can try to control their consumer communities and manipulate emergent forces among consumers to enlarge the influences. Hence, companies should be rewarded by the increased exposure opportunities and popularity of website by means of word of mouth spreading.

In summary, the conceptual model as developed in this study has served as a useful framework for academicians and practitioners to evaluate the influences of perceived interactivity, perceived hedonic value and social gain on electronic word of mouth referral likelihood and attitude toward the website. The results of this study have suggested that a successful e-business should try to design the websites in such a way that they can promote persuasion through the manipulation of interactivity, hedonic value, and social gain. Although there are a plenty of studies that focus on the theoretical and practical sides of factors to influence electronic word of mouth, there seems to be a long way to go if we want to predict the level of the electronic word of mouth effect through social or psychological aspects. Further studies are required to elaborate these phenomena.

The results of this study have suggested that a successful e-business should try to design the websites in such a way that they can promote persuasion through the manipulation of interactivity, hedonic values, and social gains.

Research Suggestions

Although the results of this study are fruitful and these results may contribute to the existing literature for further validation, several suggestions could be made for academicians and business practitioners. First, this study adopted the cross-sectional research design and examined Websites at one point in time. As a result, directional relationships among research

constructs are not clear and must be inferred based on the models or theories as developed from previous studies. Due to the constraints of time and data availability, a longitudinal research is not viable in this study.

Second, the websites this study uses are book-related websites. Because the characteristics of website products are different; some perceptions of social gain may also differ. For example, in the case of luxurious goods buying, the social status of customers may have to be taken into more consideration. If consumers want to buy some high quality products, social or psychological costs due to the disseminating of wrong information might need to be taken into more consideration. Therefore, future studies can focus on the comparison of different kinds of websites, especially on the construct of social gain.

Third, interactivity might need more time to perceive. Therefore, consumers who have been purchased the products of the target website might have deeper involvement of the perception of interactivity and hedonic value. Future research needs to focus on the person who has purchasing experiences of the target website.
Finally, this study adopted a survey methodology using Internet respondents as our samples. It is extremely difficult to know the characteristics of the Internet population. Because the Internet population is not precisely identified, the extension of research results of this study should be restricted to the scope of samples.

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DIGITALIZING SMES IN THE ERA OF E-COMMERCE LESSONS LEARNED FROM SMES' INDUSTRY PORTALS DESIGN

Dr. Jau-Rong Chen, Ming Chi University of Technology, Taiwan
kellychen@mail.mcut.edu.tw
Dr. Tzu-Chuan Chou, National Taiwan University of Science & Technology, Taiwan
tcchou@mail.ntust.edu.tw
Dr. Jung-Te Wang, Ming Chi University of Technology, Taiwan
jtwang@mail.mcut.edu.tw

ABSTRACT

Nowadays, advances in the filed of computer networks and Internet have increased the significance of e-commerce. There has been extensive research on knowledge management (KM) related to information technology (IT) at a corporate level and/or in collaborative supply chain, but relatively little attention has been given to small and medium-sized enterprises' (SMEs) learning processes that form the critical part of knowledge acquisition in knowledge portals, the industry portals. Using empirical data from Taiwanese SMEs' industry portals as a case study, this study seeks to demonstrate how design sciences may offer industry development some new methods, approaches, and processes. Through the lens of decision principles of SMEs' industry portals, we explored the roles of industry portals and found that the adoption of industry portals in Taiwanese SMEs consisted of extensive partnership networks which formed the basis of the Taiwanese production and marketing systems and was an essential resource for contributions to successful implementation of domestic and global business strategies This study also found that Taiwanese SMEs formulated and enacted strategies which leveraged information systems resources to enhance industrial KM, establish strategic relationships and develop dynamic capacities in terms of three typologies industry portals design, information platform, service platform, and matchmaking platform. This research also discovered several factors that might affect SME's knowledge absorptive capacities. These factors are (1) industrial characteristics; (2) industrial information capacity and product digitizing divide; (3) the renewal and maintenance frequency of industrial associations and their members' websites; (4) gatekeeper's background.

Keywords: e-commerce, knowledge management (KM), small and medium-sized enterprises (SMEs), industry portal, design science

INTRODUCTION

Nowadays, advances in the filed of computer networks and Internet have increased the significance of e-commerce. Recent literature reveals that many companies are now moving to building enterprise information portals (EIPs) to streamline access to information, thereby easing the task of transforming data into knowledge and helping in efficient KM using various Web technologies (Kim et al., 2002, Ryu et al., 2005). Furthermore, through electronic networks, companies can achieve integration by tightly coupling processes at the interfaces between each stage of the value chain (Lin et al., 2002). Companies are therefore redesigning their internal structure and external relationships, creating knowledge networks to facilitate communication of data, information, and knowledge, while improve their absorptive capacities (Caldeira and Ward, 2003).

There has been extensive research on KM related to information technology at a corporate level and/or in collaborative supply chain (Lin et al., 2002), but relatively little attention has been given to small and medium-sized enterprises' (SMEs) learning processes that form the critical part of knowledge acquisition in knowledge portals, the industry portals. Indeed, it is very true that SMEs make substantial contributions to national economies and the expected role of entrepreneurial SMEs as the key source of competitive innovations (Jutla et al., 2002, Gray, 2006). However, SMEs are constrained by their limited resources and expertise (Standing and Stockdale, 2003; Stockdale and Standing, 2006). As the results, SMEs are not capable to developing their information portal solely by themselves as the development of enterprise information portals is a costly initiative (Chan and Chung, 2002, Chou et al., 2005). It is understandable that governments invest heavily in projects to increase SMEs' adoption of e-commerce via the help from industry associations, as industry associations could help SMEs to reach basic system and aggregate flexibility and agility by means of developing industry portals.

However, it is argued that industry portals implementers should view their user community as a number of distinct segments in order to address divergent needs more specifically (Scheepers, 2006). That is as opposed to a 'one size fits all' approach. The reasons are, for each identified segment, a mix of content, distribution, promotion and price should be considered.

Industry portals integrated with internet industry databases and e-commerce platform can serve as a single window service for industries and are increasingly being used for collective information processing and knowledge retrieval (Chou et al., 2005; Guillaume and

Charnomordic, 2001). However, from a KM perspective, how industry portals recognize, assimilate and apply knowledge from external environment has not yet been convincingly demonstrated. Furthermore, how do the capabilities of the industry portals and characteristics of the industry associations, their work systems, there members, and their development and implementation methodologies together determine the extent to which that their purpose are achieved are also not yet been discussed (Hevner, et al., 2004).

To address this gap, this paper aims to elaborate the absorptive capacities of SMEs' industry portal by manes of case studies of SMEs' associations, Taiwan Toy and Children's Article Manufacturers Association (TCMA), Taiwan Florists' Transworld Delivery Association (TFTD), and Taiwan Electrical and Electronic Manufactures Association (TEEMA). This study aims to explore how the industry portals may develop their absorptive capacities of knowledge that can enhance the overall performance of SMEs' e-commerce implementation. Through the lens of design principles of SMEs' industry portals, we explored the role of industry portals in Taiwanese SMEs and found that the adoption of industry portals in Taiwanese SMEs consisted of extensive partnership networks which formed the basis of the Taiwanese production and marketing systems and was an essential resource for contributing to successful implementation of domestic and global business strategies This study also found that Taiwanese SMEs formulated and enacted strategies which leveraged information systems resources to enhance industrial KM, establish strategic relationships and develop dynamic capacities.

THEORETICAL BACKGROUND

KM has captured increased attention in today's global business environment, because it views intellectual capital as manageable and suggests frameworks to help companies utilize this valuable strategic resource (Jih et al., 2005). Recent growth in the KM industry is helping to drive demand for portals, and the simplicity of portals foster extremely high levels of usage on an enterprise scale/SCM/industry scale. Information portals are expected to facilitate KM by promoting utilization of dormant data, and by reducing information overload (Kim et al. 2002; Yang et al., 2005). For many industries, the importance of knowledge as the basis of future competition is an established fact (Davenport el al., 1998). Industry portals enable business benefits such as improved customer service, innovation, faster time to market, and competitive advantage will always resonate with SMEs'. However, industry portals' members may remain a largely untapped source for such knowledge creation. SMEs' resistance to acceptance of industry portals has being increasingly observed. In their case study, Chou et al. (2005) focus on the performance evaluation of industry portals by means of three different objectives including data quality, technology acceptance, and knowledge distribution.

Cohen and Levinthal's (1990) concept of absorptive capacity promoted a wide range of research on knowledge transfer between organizations. In their discussion, absorptive capacity refers to the ability of an organization to recognize the value of new, external information, assimilate it, and apply it to commercial ends. They suggest that absorptive capacity is an organizational capability developed through the process of internal R&D in a specific specialism or domain of knowledge, so making the organization more receptive to absorbing knowledge from external sources. However, as Tsai (2000) argues that much less attention has been focused on the process of gaining knowledge access from literature. That is, getting access to new knowledge requires networking effort that is different from investing in R&D. That is true that absorptive capacity is an attractive though difficult to achieve goal. The abilities of SMEs to make use of knowledge and information from both inside and outside the organizations are crucial, yet by no means simple to manage or facilitate. According to Hevner et al. (2004), there are two paradigms characterize much or the research in the information systems (IS) discipline: behavioral science and design science. Bother paradigms are foundational to the IS discipline, positioned as it is at the confluence of people, organizations, and technology. By developing industry portals, industry associations can help SMEs to reach basic system, and aggregate flexibility and agility, despite their lack resources (Chou et al., 2005). However, how SMEs' industry association deliberate associational design actions in the form of mechanisms can enhance SMEs' propensity to innovate in industry portals will be another concern. That is, the industry associations' abilities of various mechanisms to facilitate knowledge acquisition and knowledge conversion (Nambisan et al., 1999). In order to extend our understanding regarding the role of industry portals' mechanisms, based on evidence collected from three Taiwanese industry associations, this study explores the roles of industry associations and their managerial interventions. How the industry associations employ a variety of design actions to facilitate structured and unstructured interactions for SMEs will be presented.

Mainly borrowed from researchers' works (Mei and Nie, 2007; Chou et al., 2005; Davenport et al., 1998; Hevner et al., 2004; Watson and Fenner, 2000; Nambisan et al., 1999; Cohen and Levinthal; 1990), this study proposed an analytical framework as follows.

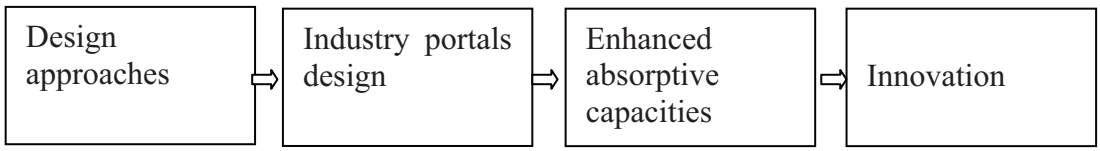

Figure 1. An Analytical Framework of This Study

RESEARCH METHODS

Taiwanese SMEs' industry portals were selected as the sites for this exploratory study for some important reasons. First, the development of e-commerce has been designed by the Taiwanese government as an important issue of investment to stimulate national economic vitality and to enhance advantage competitiveness (Jih et al., 2005). From 1999, the Ministry of Economic Affairs lunched a multi-year project to promote EC applications in 40 industries identified as having the best potential to stimulate long-term national economic development. Secondly, it is meaningful to study the role of information portal from a macro point of view instead. The experience of how industry associations design, implement, and utilize industry portals should be meaningful for use to extend our understanding regarding the issue of design science (Hevner et al., 2004).

Using Yin's book as a guide, we defined the problem we aimed to explore and collected data by a combination of methods. Data collections from 12 interviews cross 3 industry associations. The transcribed data and notes were analyzed using content analysis techniques to allow categories and themes to emerge.

The Cases: SMEs in Taiwan

The emergence of Taiwan's SMEs is closely related to the economic, social and educational policies adopted by the Taiwanese government in the past 50 years. With over 1.2 million SMEs in Taiwan, SMEs serve as the key drivers to Taiwan's economic boom. From a macroscopic point of view, SMEs encompassed 98% of all Taiwanese enterprises, and spread across multiple sectors (http://www.moeasmea.gov.tw). Since Taiwan joined the World Trade Organization (WTO), Taiwanese industries have to face increasingly fierce competition from global competitors. Therefore, SMEs have to strengthen their IT capabilities in such situation. However, the degree of information and communications technology (ICT) adoption varies greatly from companies to companies. In an effort to help transform, modernize, and encourage innovation for SMEs, it is imperative to introduce ICT to SMEs in an effort to expand their market opportunities and enhance their competitiveness. To achieve this goal, Small and Medium Enterprise Administration (SMEA), Ministry of Economic Affairs, Taiwan, conduct a series of guidance service to provide a number of services, including implementation of basic infrastructure, ICT applications, e-commerce, ICT training, and utilizing ICT to encourage and facilitate innovation in business (http://www.moeasmea.gov.tw). From information service portals, implementation of ICT, talent cultivation, accumulation of knowledge, to online sales and supply chain management, it is hoped to enable SMEs to effectively utilize the resources provided by the government to

accelerate the pace of ICT adoption.

Case 1: Taiwan Toy and Children's Article Manufacturers Association (TCMA)

http://www.taiwantoy.org.tw

Acting as a bridge between its member manufacturers and counterparts abroad, the Taiwan Toy & Children's Article Manufacturers Association (TCMA) was founded in August 1967, and currently has 232 members. According the data collection from in-depth interviews and secondary information, the profile of TCMA is present as follows:

Encountered with strong price competition from manufacturers in mainland China, Taiwan toy manufacturers have adopted a new strategy, offer high quality products and develop production lines for teaching aids and new school equipment. By means of increasing their R&D budgets, the quality and safety of Taiwan-made toys has been improving in recent years. Considering of the rich resource of IC & IT industries in Taiwan, TCMA plans to integrate all these related resource to help upgrade the toy industry. Therefore, TCMA general-director expresses "*Not only this, but we also need to integrate manufacturing, marketing, globalization and even language capabilities*".

As Taiwan is strong in the 3C industries-computer, communications and consumer electronic, local toy industry can take advantage of this strength to develop innovative toys. The combination of toys with IC technology, the innovation of intelligence-type toys and engagement in marketing, even establishing own brand are the most important strategies for most of Taiwanese SMEs in toy manufacturers.

In order to assist members create new designs, TCMA has continuously implementing programs for their members regarding the technical assistance in material selection, product design, manufacturing process improvement, molding and the introduction of complex parts and components. The government is also engaged in helping manufacturers to upgrade from OEM to ODM, even to OBM. "*Now, there are many manufacturers have upgraded themselves to ODM. Furthermore, few of them had upgraded themselves to own brand"* said from one interviewee.

TCMA continuously issues the "Toy News" monthly. The publication aims to attract their members pay much more attentions and concerns about the importance of anti-piracy and greenpeace. The major markets of this industry are including USA (41.3%), UK (8.7%), Japan (6.8%), Mainland China (4.7%), Germany (4.4%), and HK (3.8%). Therefore, TCMA proposed programs planned as follows,

1. continuously establishing and maintaining the B2B e-commerce web site for Taiwan-made toys to help their membership sell their products via Internet.
2. planning to call more members to attend the International Trade Fair for Toys.

Case 2: Taiwan Florists' Transworld Delivery Association (TFTD)

http://www.flowergift.org.tw/flower/front/bin/home.phtml

Producing a wide variety of fresh, beautiful flowers, Taiwan's Florists industry has flourished in recent years.

Through ICT guidance services provided by SMEA, TFTD constructed the TFTD e-commerce platform allowing members to quickly create their own websites to conduct e-commerce, relieving them of any worries for system operation or payments. Members achieved an average monthly cost reduction of NT$ 40,000, increased online order by 40%, and enhanced total sales by NT$ 1 million.

Case 3: Taiwan Electrical and Electronic Manufactures Association (TEEMA)

The Taiwan Electrical and Electronic Manufactures Association (TEEMA) was established in 1948 and comprises some 3,800 members, Including 2,874 (75.7%) SMEs and 923 (24.5%) large scale companies, representing the complete spectrum of companies in the electrical/electronic (E&E) sector in Taiwan. Its members are involved in the manufacture of components, electronic and electrical parts, finished products, computers and peripherals, electrical and electronic equipment and many other products (www.teema.org.tw). TEEMA serves the interests of Taiwanese electrical and electronics industries and provides a point of liaison between the industry, its customers and the government.

In the past, the sales and purchase transactions of industrial products was heavily influenced by personal relationships of buyers and sellers that were culminated over the years. Instead of dealing with a familiar person on a face-to-face basis, the virtual transaction involves an electronic exchange of information removing the non-verbal cues and communication that aided or affected the purchasing decision (Johnson and Johnson, 2005).

DATA ANALYSIS AND RESEARCH FINDING

Based on the data analysis, a comparison was conducted of different type of industry portals design seen as table 1. This study finds that in order to target SMEs with needs in operation, management, and decision making. There are three typologies of industry portals: information platform, service platform and matchmaking platform.

Portals Design

Learnt from Case 1, even though the potential international buyers just only can get the catalog listings and products information from TCMA's website, they also can easily to learn via international toys show that innovation-oriented is TCMA's niche. By means of conduct

seminar and workshops regularly, TCMA aids to promote their members' abilities to catch more business opportunities. Furthermore, TCMA disseminate the information via website and database access. For Case 2, the TFTD is service-oriented. To satisfy the requirements from B2B and B2C, the operation management is needed, including the enterprise operation models. For e-commerce, the online ordering, payment, and procurement are built. What is more, technology facilitates the exchange of goods and services in a global marketplace. No longer can suppliers of industrial products use traditional face-to-face relationships to sell its products. For TEEMA, the industry portals can be seen as a matchmaking platform as its function mainly aims to building B2B networking.

Absorptive Capacities

Regarding of catering to the vary needs of their members, TCMA, TFTD and TEEMA all provide a series of training programs such as workshops, seminars, and professional training course. These training programs delivered via live activities and internet. By means of the strategic partnerships and resource-sharing concepts to formulate their own industries portals, A series of knowledge, financial, sales channels, and technical colleges provided, to retain their industries core competencies and competitiveness, it is believed that only by continuously learning, educating and developing their members. Learnt from this study, Case 1 is innovation-oriented; Case 2 is domestic market-oriented; and Case 3 is export-oriented. However, due to the characteristics of industries, their knowledge utilizations are quite different. For Case 1, the international toys show is the most important activity for TCMA. The issues of customer modeling and segmentation are vital for TFTD. For Case 3, the industrial alliance and government contract bid can't be neglected.

What is more, this research also discovered several factors that might affect SME's knowledge absorptive capacities. These factors are (1) industrial characteristics; (2) industrial information capacity and product digitizing divide; (3) the renewal and maintenance frequency of industrial associations and their members' websites; (4) gatekeeper's background. Data from three cases is summarized in table 1 to highlight some key features, industry associational mechanisms, industrial portals design by a description as follows.

Table 1, different type of industry portals design

		Critical issues	Case1 TCMA (232 members)	Case 2 TFTD (120 members)	Case 3 TEEMA (2,872 SMEs)
Typologies of Platforms		*Corporation Operation service *e-Network Framework	*Information Platform for Trading Opportunities *B2B (Buyer and Supplier)	*Service Platform *B2B,B2C	*Matchmaking Platform *B2B, Network
Portals Design	e-Infrastructure	Information Portal	International Commerce	Operation Management	Market Intelligence
		Talent Cultivation	*Promotional Abilities *Seminars and Workshops	*Fundamental Abilities *ICT forums, training courses	*Assessment Abilities *Enterprises Professional Training
		Communication and Networking	Business Opportunities	Increases in Broadband Usage	Business Opportunities
	e-Application	e-Operations	Industrial Alliances	Enterprise Operation Models	Supply Chain Integration
		KM	Service Capacity and Quality Enhancement	Awareness Promotion	Strategy Implementation
	e-Commerce	Online Sales	Catalog listings and product information for potential buyers	On-line ordering, payment, membership, and procurement.	On-line payment and procurement, logistics service
		MIS	Toy Manufacturers Computer System (TMCS), Toy Sales Computer System (TSCS)	Payment system CRM	Payment system SCM
Absorptive Capacities		Knowledge acquisition	Innovation-oriented	Domestic market-oriented	Export-oriented Interface friendly
		Knowledge dissemination	*Via website and database access *e-publication	*Via website and database access *training program	*Via website and database access *professional

		*seminars and activities conducted	conducted	training course organized
	Knowledge utilization	*International toys show	*Customer modeling and segmentation	*Exhibition *Industrial alliance *Embarking *Government contract bid
Innovation	Product innovation Process innovation	Product innovation Process innovation	Process innovation	Process innovation

CONCLUSION

The globalization of the economy is forcing many enterprises to change in order to survive. To compete in these global markets, many manufacturing and servicing SMES need to develop new business strategies and employ new technologies (Caldeira and Ward, 2003). Learned from this study, industry portals represent as a promising avenue by enabling SMEs to interact directly with customers and integrate efforts of networks members. The improved innovative capacity resulting from thorough execution of market strategies helps SMEs' to establish and sustain competitive advantage by providing unique, attractive customer values. This study contributed that there are significant network partnership between how SMEs apply e-commerce and how they practice IT-enable interoganizational KM in their operations. It is true that IT alone does not guarantee success of either e-commerce applications or KM implementations. However, IT does represent an essential component, since IT infrastructure can be aligned properly with business strategy and operation processes to create synergies. Taiwanese SMEs recent success in manufacturing IT-related hardware and software and service industry are really a natural fitness to the need for e-commerce applications and KM implementations.

As notes in this study, the hardware and software tools acquired for e-commerce applications can be useful for promotion of interorganizational KM activities. That is, e-commerce applications are guided and supported by the active KM programs. The SMEs' industry portals in Taiwan, as demonstrated in this study are similar to SMEs in other parts of the world with regard to the facilitation effect of e-commerce on KM in terms of three typologies industry portals design, information platform, service platform, and matchmaking platform. Hopefully, the findings of this study could extend our understanding regarding the e-commerce and KM research by providing empirical evidence obtained from Taiwanese SMEs' industry portals.

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INTERNET SECURITY,RISKS AND MINOR GUARDIANSHIP

Dr. Augusto Sebastio-University of Bari, Italy
ausebas@tin.it

ABSTRACT

Networks and computers have changed our life style. During the day we are always connected and we receive information from mobile phones and internet. Using World Wide Web without any kind of protection could be dangerous. We don't know who is connected, from where is connected, where the server is situated, the real intention on the other side of the world and we often use technology without thinking about risks related to our information, our privacy, our safety, our identity. Digital divide could be a big barrier not only for the access to information, for a question of democracy, but also for technological reasons and for economic problems. The population of the world is divided in users and non-users. One of the most important effects of digital divide is under profile of education, the difference of technologic capacity between teachers and pupils, parents and children. This research illustrates how we approach the net in easy-way without considering risks and technological effects. The current research is an excursus of dangerous consequence of using web without Knowing risks for security and minor guardianship

Keywords: Internet, security, risks, ecommerce, guardianship, malware, children, innovation, software

INTRODUCTION

Internet is a new territory with rules and laws. At the beginning it was considered a no man's land. Starting from a new Military Technology called Arpanet in 1960, developed for military uses, Internet is today the best form of communication in the world. The Net is a worldwide network of interconnected computer network that transmit data by packet switching using the standard internet protocol (IP). It's therefore a network of networks that consists of million of smaller domestic, academic, business and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other documents of the world wide web. Internet security is the prevention of unauthorized access and/or damages to computer system via internet access, but at the same time internet security is the new target for guardianship of teenagers in World Wide Web. Is now accepted, in all over the world that internet security and risks connected to the use of Internet are strictly related and have multiple steps in common. Internet security is not only a problem of safety of documents, contracts, information, but it's a problem on different levels of the world society. It's a problem of privacy, a problem of education and a problem of

culture. The first point of view to discuss is what is generally known as digital divide. The difference between rich countries and poor countries is increasing more and more and close to the wound of analogic alphabetization there is what is called digital divide. Digital alphabetization is developing faster and faster and the division of the world in connected and unconnected people is a social weak point to handle with care. Facing this new social problem inside the same country or the same part of the world is a question of conscience. We have to consider that e-democracy it's only a part of the most important problem of democracy in particular geographic area but, as it's known, not all the population of the world has free access to internet services and information and it could be a consequence of money, or a politic choice based on the control of independence and information in countries against democracy. So the meaning of the words "free access" is wide, too ample to close it in a few words . It concern access to internet services without money and copyright and complete access to web information not under control. The discussion is huge and it involve human rights and social programs and it will probably absorb the work of all the world institutions and it probably takes a new Breton Woods in the field of Democracy and Privacy.

What we would like to focus is the problem of safe internet use, intended without any form of control and risks for people in general and children in particular. The web from the one hand, in his economical prospect, it's an un-material market and the best way to develop commerce easier. It appears to be essential for company's survival and growth. Developing e-commerce is possible to reach people on the other side of the world and reach new countries and markets improving capabilities and the time to market. The security of e-commerce system, which ensures authorized and correct transaction processing possibly without risks and threats, is one of the most critical issues in implementing the system. The return of investments in technology could be very fast even without a unique law system for international transaction in e-commerce, but on the other hand internet must be an open-source technology to find information, a service offered from the society to citizens without being afraid from technology.

During the connection on the web we don't know if somebody is controlling our personal computer, our time of navigation, our interests, our documents, our work.

This behaviour fill ourselves un-safe, we don't know the reason of this control. Sometimes it could be only for safety territorial programs as fighting terrorism, sometimes it's only because of commercial reasons as marketing, that find on the web a specially way to catch information about a person that could be used for marketing one-to-one, often for unsolicited

bulked email called “spamming”, sometimes it’s just a way for identity theft, a way to enter on private information as banking account or credit card for using the identity of another person. Crackers generally use the identifying private code given for home-banking to transfer amount of money in other banks account on the other side of the world with anonymous format and uncontrolled system.

It’s impossible to know if our information, credential, interests are stolen for commercial uses, for identity theft, for social uses but the main problem is that we don’t know who is the person we are connected with, his or her real identity.

A part from the problem of what people, especially young people, do when they are connected, there is a growing interest about the fact that we don’t know the identity of the person who is connected on the other side of the net, the sex, the age, or if we are chatting with more than one person and their intention. The risk is that without any kind of protection our personal information could be recorded and used in different ways. Most security measures involve data encryption and password. In this new field there is the possibility to commit crimes, also new forms of crimes, with the advantage that the internet behaviour could be not discovered from anyone. Is difficult to show that exactly in that moment there is one person instead of another one, connected at that computer we cannot be sure about the identity. Before using a personal computer we have to point the attention to “malware”, malicious software, invasive and unsolicited software capable of self installing. More in general there are many measures to defend security of information and documents, but we have to distinguish systems of protection in analogic systems of safety like: locking closets, using keys to defend documents, change disposition and places; and systems called digital measures like: introducing a password, using token, badge to enter in a place or in a file, using Biometry systems to recognize people. One of the most simply measure of safety for instance is to create a password made of small letters, numbers, capital letters, points, comma. One of the best solutions to apply is always a frequent change of the password at least every three months without using name and dates important for yourself or your family. Is very important to apply this form of prevention to protect your personal computer from external attack. Using badge and token to confirm the presence and the identity of a person entering a building or a program is a very important application. As we have just said the new frontier in the field of safety is Biometry system like: finger printing, geometry of the face, map of the vein of the eyes, sound of the voice, geometry of the hand, heartbeat. This kind of measures has the problem of natural changing related to the time. Sometimes there is

the possibility that this characteristic could change like the voice during a cold or under the effects of smoking. At the same time is possible, or better is natural to change the geometry of hands during the life, because of the difference between the moment of recording information and the time of using. A professor from Japan used the finger print on a glass to reproduce a copy of a hand and apply this hand on a biometry system to be recognized with another identity. The operation was very important because starting from that time the entire world understood that biometry system could go easily on fault.

In every office there are many memories to defend: computer, printing-machine, and everything could record a word or a file.

There are good software to learn and to improve the use of the computer but at the same time there are what are called “malware” self-installing software negative programs during a normal use of Internet: Worm. Trojan Horses, cookies, metatag, virus. Systems that work to record private information from the computer, used to commit crimes, used for marketing one-to-one, to send bulking email, to record the time of the connection, sites visited, what you like, what you prefer, who is your favourite actor, sportsman, what sport do you like, what kind of food do you prefer.

In this way all private information are on disposition of crackers and hackers and the word privacy, in the modern concept, returns to medieval idea of something possible only in man’s mind.

These perpetuators can use the information to commit crimes: blackmails, identity theft(use credential of a person to open the home banking system for buying, selling, open new credit cards, transfer money in other parts of the world. In internet is also difficult to trace money. It’s possible to transfer a big amount of money form an account to another without tracing money. In this way the money is like the money used in a Casino’, money that you can change every moment in cash without knowing the provenience. This way is always used for cyber-laundering, the easy way to wash dirty money. World Wide Web is also used to send people markets information or unsolicited message. This pervasive system based on internet email-address consists of sending unsolicited email to email address. The name of this practise is spamming(from the name of a commercial brand). Without the consent of people is not possible to use email-address for sending marketing-message or message in general. A part from the problem of contents from an educational point of view and the vice of consent there is the proliferation of unrestricted internet access has brought the community unsolicited email phenomenon. At the beginning this process was underestimated but after a

period of ten years it's now recognized as the worst problem related to the web with a big social cost. We have to consider that for developed nations technology factors are most strongly associated to education and they give prior importance in development ICT. The cost of anti-spam measures, filters, firewall, disaster recovery procedure, patch, antivirus, anti-spyware is increasing more and more and not only for private people but far all the society in a special way for public administration on-line services. The possibility of loosing information is today the worst thing that could happen. More often than not another most useful measure, recommended by law, to record information is the back up of information on cd-rom, dvd, floppy, flash-pen and so forth…if the system is under attack of a virus is better having a memory aside. This is the best method to prevent damages for your job, with the possibility of a new download from this outside memory on your computer memory. This is exactly what happens with the procedure of disaster recovery. A sort of contemporary file recovery in different memories and places was acted on the 9/11 tragedy. All the documents of the Twin Towers in New York were stored in another place of the United States and all this documents were saved.

A very short and unsatisfactory list of Prevention Guidelines for personal computer could give an idea of the attention necessary to consider in the field of prevention from risks and malware attack:

- Keep your computer current with latest patches and updates
- Make sure your computer is configured securely
- Choose strong password
- Follow continual evolution of system
- Use security software
- Update software every day
- Change password every three months
- Everyday back-up
- Tailor made document of the measures applied and changed
- Frequent control of memory-print
- Use cryptography for important documents
- Use digital signature for important documents
- Use electronic post certification
- Singular access to the computer

This list could be only a first approach for safeguard of privacy on the web and to keep documents out of risks.

As we have said digital divide is a problem of the world society, and it's made not only by the point of access or not, but also is determined by factors such as income, employment, and education. We can say that is not only a problem of using technology between male and female, but also a generational problem, a question of age that refract his consequence in educational system incapable of control new generations. If the computer is a toy for boys and not for girls at the same time it's a gadget for parents. Many times is used for video-games given to children without attention and responsibility because there are different kinds of videogames and many of themes are full of violent scene, murders and pornographic images. Even if they are forbidden for a question of age, they are usually sold to parents without control from them about the meaning of the game or of the cartoon.

Is scientifically tested that the constant repetition of a bad behaviour for hours, even if in a videogame, could convince a young and un-experienced mind that the behaviour is allowed. Social dangerous phenomenon like car-surfing is directly taken from videogames, and young boys repeat this behaviour without emotions putting themselves on life-risk.

Internet security and risks is considered important for minor guardianship and education comparing with the roll of technology in currently education in the new form of learning named e-learning, World Wide Web form of research as the case of wikipedia, the benefits of availability of technological instruments in school and digital divide between teacher, tutor, students, parents, and children. Technology is a new frontier for students, they have the possibility to be active part of the system of teaching and not to be passive bystanders of their education, but we have to consider risks related to the web during the time of using. The impact of certain images on students minds, the impact of meeting-web-rooms, chat-rooms, blogs, communities, mailing list with unknown participants. The problem studied is not the time of connection but the quality of programs and software. Even five minutes are enough to see the wrong image or to red the wrong message. The possibility to meet strange and dangerous people without control is the worst thing of internet system.

A very short and unsatisfactory list of Prevention Guidelines for internet children use and policy necessities

- Special technological programs for children and parents
- Increase of technological knowledge for parents and teachers
- Special police departments vs. cyber-crimes in every State

- International police for cybercrimes
- Special control vs. paedophiles
- Special software filter vs. paedophiles
- Automatic firewall system for computer
- Special category for crimes and laws

New forms of technology programs have to be considered in relation to privacy and social approach are individuated in:

- Street google
- Second Life.
- Facebook
- My space

The social network as a result of difficulties in social life it's a new frontier of studying and it deserve a deep consideration. For new generations is easier to chat and to hide the real identity with behind a technological wall, rather than show themselves in a real life(neet, freeter, hikikomori). They live every difficult as a defeat and prefer to live in a software world in which they can be everything they want. In second life for instance they could have a new identity, they could choose a perfect avatar which represents their dream without imperfections. The hope is to convince politicians of the importance of educational systems for the web respecting privacy. It could be at the same time an incredible instrument for education, ecommerce, public administration, international policy, but it's not possible to use this web-toy without rules.

Internet will be our future and in this future we want to be safe in the un-material world and so it's necessary to act policy to reduce every kind of digital divide in the world, in every field. We cannot stop technology because we cannot stop the time and we want in our future more safety than our present.

CONCLUSION

The hope is to convince politicians of the importance of educational systems for the web respecting privacy. It could be at the same time an incredible instrument for education, ecommerce, public administration, international policy, but it's not possible to use this web-toy without rules.

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ASSESSING THE ROLE OF AGE AND GENDER ON THE PROPENSITY TO ENGAGE IN SOFTWARE PIRACY

Dr. Vatcharaporn Esichaikul, Asian Institute of Technology, Thailand
vatchara@ait.ac.th

Dr. Trevor T. Moores, University of Nevada Las Vegas, USA
trevor.moores@unlv.edu

ABSTRACT

In spite of international treaties and copyright laws in most countries protecting intellectual property rights, the illegal copying, distribution and sale of digital media continues to be a multi-billion dollar problem. The U.S. Immigration and Customs Enforcement agency estimates that global counterfeiting and piracy costs the U.S. economy over $200 billion a year. Software piracy is one of the most lucrative, with an estimated $47.8 billion of pirated software in use around the world. In this paper, we use the cognitive-developmental approach and gender socialization theory to examine the propensity that someone will engage in software piracy.

The cognitive-developmental approach (Kohlberg, 1969) suggests that people become more ethical as they mature, progressing through a number of stages that define one's evolving understanding of one's place in society. Females typically progress to a level of ethical thinking based on empathy (stage 3), while males typically progress to a level based on the rule of law (level 4). Gender socialization theory (Gilligan 1982), on the other hand, suggests that differences in the viewpoints expressed by males and females is due to the different roles males and females are meant to have in society. Females are brought up to be more caring, while males have a more justice-oriented upbringing.

Based on these two theories and recent literature, we expect that older people will exhibit a more ethical viewpoint and be less likely to engage in software piracy, while males are more likely to engage in software piracy than females. Furthermore, the dependent variable for most models is the intention to engage in software piracy, we use behavior defined in terms of buying, sharing, and using. Buying and sharing are two ways in which someone can acquire pirated software, while using is end-result of piracy. The unique contribution of this paper is defining behavior in terms of buying, sharing, and using. The research model is given in the Appendix.

Using a 2-way MANOVA, we examine differences in the propensity of buying, sharing, and using pirated software for a sample of graduate students in Thailand. We find the level of reported buying is low, although the level of use and sharing is high. Males are more likely to buy, while females are more likely to share. The only age-related difference relates to sharing, with older people less likely to share. We suggest anti-piracy campaigns have succeeded in reducing the sale of pirated software, but other channels have been established that allow the practice to continue, with males continuing to buy, but females being the main source of diffusion from that point onwards. In opposition to much of the recent literature, we

find little evidence of differences based on age, suggesting the need for software remains high for our sample of full-time and part-time students.

The response of software vendors to software piracy has been to take a two-pronged approach, where regular raids on businesses have stressed the criminal aspect of using pirated software, along with initiatives that provide low-cost software suites to governments and students in developing countries. We conclude, however, that the underlying problem of the cost of legal software remains. In particular, the cost of an OEM version Windows Vista Business is 74% of Thailand's per capita gross national income. We conclude that significant reductions in software piracy are unlikely to be achieved until these economic issues are addressed.

Keywords: Cognitive developmental approach, Gender socialization theory, Intellectual property rights, Software piracy.

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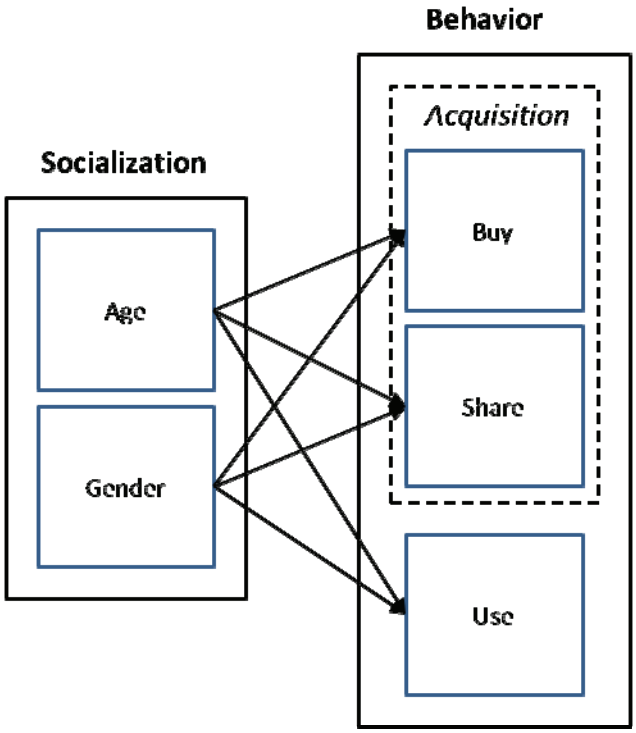
Appendix. Research Model



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EXPLORING BLOGGERS' MOTIVATION AND BEHAVIOR IN THAILAND

Nuchada Dumrongsiri, Assumption University, Thailand
ndumrongsiri@hotmail.com, nuchadadmr@au.edu
Vikanda Pornsakulvanich, Assumption University, Thailand
dr.vikanda@gmail.com

ABSTRACT

Blogs have evolved exponentially as a global phenomenon where scholars have attempted to answer why and how people use blogs. An active weblog requires a long-term commitment and much effort from a host to frequently update the contents as well as from users to regularly interact with the webblog. Thus, an investigation on what motivate people to blog interactively may help us develop and promote blog usage to fulfill various needs of the users better. This study serves two purposes: (a) to discover the reasons why people blog and (b) to investigate the relationships of how motives influenced blog usage. Different from previous research, this study used both qualitative and quantitative approaches to explore blog motivations directly from users. The findings revealed five blog motives: new friendship, relationship maintenance, passing time, social influence, and self-expression. Relationship maintenance, new friendship, and passing time were significant predictors of length and duration of blogging. Gender differences were significant in relationship maintenance motive and time spent on blogs.

Keywords: Blogs, Motivation, Blogging behavior, Gender differences, Thailand

INTRODUCTION

Weblogs, also known as blogs, have evolved dramatically as tools of online social networking. A blog refers to a website that is maintained by an individual with regular provision of comments, descriptions of events, information on specific interests, and other materials such as graphics, photos, videos, movies, and music (Huang, Chou, & Lin, 2008; Technorati, 2008). According to *Technorati* (2008), a blog search engine, 77% of active Internet users read blogs. It is estimated that there are 133 million blogs in the Blogsphere with 900,000 blog postings in 24 hours (Technorati, 2008).

The remarkable growth of blogs turns blogging into a global phenomenon where scholars have raised questions of why people maintain blogs, what they communicate on blogs, and how they use blogs in comparison with the mainstream media (Hsu & Lin, 2008; Johnson & Kaye, 2004; Kim, 2008; Williams & Merten, 2008; Yang, 2007). The early bloggers may use blogs as their personal homepage or online diary (Jung, Youn, & McClung, 2007). However, blogs are surfaced through Internet that allows interactivity and social networking among users around the world. When a personal blog begins to serve as a mass medium, the line is less clear between characteristics of the personal blog and those of the mainstream web sites (Technorati, 2008). Several organizations started their own blogs for information and social networking purposes such as CEO blogs and newspaper blogs. These corporate blogs serve as a two-way communication tool to interact with, establish agenda, and shape opinions of customers and employees (Marken, 2005).

The next question to understand the blogging phenomenon better is to ask why blogs are widely accepted. The answer to this question may lie in an explanation from bloggers on why they use blogs. Bloggers, as hosts and readers, need to be willing to actively participate in blogging. An active weblog requires a long-term commitment and much effort from a host to frequently update the contents as well as from users to regularly interact with the webblog. Over 60% of weblogs have been abandoned after they are created (Hsu & Lin, 2008). Thus, an investigation on what motivate people to blog interactively may help us develop and promote blog usage to fulfill various needs of the users better.

This study serves two purposes: (a) to discover the reasons why people blog and (b) to investigate the relationships of how their motives influenced blog usage. Different from previous research, this study used both qualitative and quantitative approaches to explore blog motivations directly from users. The theoretical framework and past research were presented in the next section.

USES AND GRATIFICATIONS

Uses and Gratifications (U&G) serves as a theoretical framework to explain blog gratifications among blog users in Thailand. U&G has been used to explain uses and effects of interpersonal and mediated communication channels (Rubin & Bantz, 1989; Rubin & Rubin, 1989; Rubin, Perse, & Barbato 1988) as well as uses and effects of new media technologies (e.g., Flaherty, Pearce, & Rubin 1998; Papacharissi, 2002; Pornsakulvanich, 2006, 2007).

U&G is based on a psychological perspective that emphasizes an active role of people in selecting media to fulfill their needs. The theory focuses on explaining how and why people use the media rather than how the media influence people (Klapper, 1963). Fisher (1978) proposed that "communicators actively control the information they process" (p. 156). Active communicators will select what information they prefer to receive, what information they will remember, and what information they wish to convey to others. A. M. Rubin (1993) suggested that a valid view of audience activeness lies between "(a) being 'passive' and expected to be influenced by the communicated messages, or (b) being 'active' and expected to make rational decisions about what media content to accept or reject" (p. 98).

U&G has been studied, expanded, and revised over the years (Katz, Blumler, & Gurevitch, 1974; Palmgreen, 1984; Palmgreen, Wenner, & Rayburn, 1980; Rubin, 2002; Rubin & Windahl, 1986). According to Rubin (2002), the theory rests on several assumptions. First, people are active, goal-directed, and motivated in selecting media. Second, people select and use the appropriate channels of communication to gratify their needs and wants. Third, different people have diverse communication behaviors, which are based upon social and psychological factors. Then, social and psychological situations influence how well media can satisfy people's needs and wants. Next, media can be functional alternatives to other channels of communication. Lastly, people are usually more influential than media, but not always.

Katz et al. (1974) suggested that motivation influences communication choices, strategies, and behaviors. Scholars have examined motives for using various types of new media technologies such as cable television (Becker, Dunwoody, & Rafaeli, 1983), political bulletin boards (Garramone, Harris, & Anderson, 1986), VCRs (Rubin & Bantz, 1989), remote

controls (Ferguson, 1994), the Internet (Charney & Greenberg, 2002; Papacharissi & Rubin, 2000; Pornsakulvanich, 2007; Wolfradt & Doll, 2001), and a personal web page (Papacharissi, 2002). For example, Rubin and Bantz (1989) suggested that VCR motives reflected both interpersonal communication needs (e.g., socialization) and mass communication needs (e.g., entertainment). Charney and Greenberg (2002) specified eight Internet motives: keep informed, diversion, peer identity, good feelings, communication, sights and sounds, career, and coolness.

As guided by U&G, motivation is a major concept to understand media use, selection, and behavior. This study focused on motives for using blogs. Weblogs serves as a diversified and boundless place where prospective consumers of various services and products express and reveal themselves. Thus, blogs have brought an opportunity for practitioners and scholars to publicly access personal information and understand the reasons, both socially and psychologically, why and how people use blogs to fulfill their needs. As more and more people become bloggers, a better understanding of blog motives and behavior will allow us to interact and network with bloggers in a more productive and innovative ways for academic, commercial, and business purposes. Literature pertaining to blog motives and behavior are reviewed and discussed in the following section.

BLOG MOTIVES AND BEHAVIOR

Past research on blogs have explored and classified blog motives and behavior differently through various perspectives. Some studies employed a social networking framework. Lento, Welser, Gu, and Smith (2006) indicated that social ties were not equal to influencing bloggers to remain active. Rather, pre-existing social ties attracted participants and results in a higher rate of blogging retention. Williams and Marten (2008) examined online social networking contents and found that adolescents participated in blogs to share family and social issues, discuss risk behavior, disclose personal information, and interact with peers.

Most studies examined blog motives and behavior based on blog writers' perspective. Nardi, Schiano, Gumbrecht, and Swartz (2004) unfolded five blog motives through in-depth interviews with bloggers: to document life experiences, to provide commentary and opinions, to express deeply felt emotions, to articulate ideas through writing, and to form and maintain community forums. Similarly, Huang , Shen, Lin, and Chang (2007) found five motivations as predictors of information-oriented and interaction-oriented blogging behaviors (i.e., self-expression, life documenting, commenting, community forum participation, and information seeking). Moreover, Jung et al. (2007) reported five motives on hosting personal weblog similar to Papacharissi's (2002) motives on hosting personal homepage: entertainment, self-expression, professional advancement, passing time, and communication with family and friends. Nevertheless, new trend was not a salient motive for blogging.

Several scholars attempted to investigate blog motives through readers' perspectives instead. According to Beaubien (2007), about 50% of survey respondents read blogs for entertainment and learning about specific interest. Huang et al. (2008) revealed four motives for reading blogs: affective exchange, information search, entertainment, and getting on the bandwagon.

Altogether, the literature on blog motives and behavior provides consistent evidence that blog users, as writers and readers, tend to participate in blogs due to similar reasons. Generally, people use blogs as functions for documentation, self-presentation, social interaction, and

entertainment. Previous research have applied motive scales for a certain medium to examining blog motives (Huang et al., 2007; Jung et al., 2007). However, blogging may possess particular characteristics different from traditional and online media, leading to different motives and use. For example, blogs are perceived as better sources of information and more credible than the mainstream media because they provide opinionated, analytical, personal, and independent contents (Johnson & Kaye, 2004). An exploration of blog motives inductively from users' self-reported reasons enables us to clarify blog motives and develop a scale to measure them more precisely.

This study aims to provide a supplement to existing findings through a different research method. Both qualitative and quantitative approaches were used to incorporate blog motives emerged directly from open-ended questions with those from a rating scale. Additionally, this study is among the first to provide empirical evidence of blog motives and behavior in Thailand. Little is known about how and why blggers in Thailand use blogs. The findings from our investigation would encourage and promote blogging to serve purposes for academia and business sectors more efficiently. Two research questions were proposed.

RQ1: What were motives for using blogs?

RQ2: How did blog motives predict blog use?

RESEARCH DESIGN AND METHOD

This research study employed a cross-sectional design and included two data collection to answer the two research questions. The first study used qualitative analysis to explore blog motives in Research Question 1. The second study used quantitative approach to verify the blog motives and examine their relationships with blog use in Research Question 2.

STUDY 1

Sample

Participants (N = 281) were undergraduates who currently enrolled in classes at the large international university in Thailand. A screening question asking whether the participants have used blogs (e.g., Hi5, facebook, myspace) in the past three months was presented as the first question. Thirteen participants who reported "No" were excluded from the study. Thus, the sample included 268 participants. Then, participants were asked to indicate a reason(s) why they used blogs in an open-ended question. They also responded to several questions asking about the blog that they used the most, a number of months that they have used blogs, time in hours and minutes that they spent each time and weekly on blogs, and a location where they usually accessed to blogs. Finally, they completed demographic questions about gender, age, income, and college year.

Participants were 171 females (63.8%) and 97 males (36.2%). They were in age ranged from 18 to 28 (M = 21.01 years old; SD = 1.46). One hundred forty participants (52.5%) were senior students, 63 participants (23.5%) and 62 participants (23.1%) were sophomore and junior students, respectively. Only two participants were freshmen.

About 78.7% of the participants specified *Hi5* as the blog that they used the most, 12.3% mostly used *Facebook*, 3.7% mostly accessed *YouTube*, and less than 3% reported *MySpace* and others as the blog that they mostly visited. Also, participants reported a varied number of

months that they had used blogs with a range from 1 month to 48 months (M = 18.19 months; SD = 13.84). About 22.6% of participants had used blogs for 12 months, 11.7% had used blogs for 24 months, and 11.3% had used blogs for 36 months.
Approximately, 21.1% each spent 30 minutes or 60 minutes on blogs each time, 12.0% spent 90 minutes, 11.3% spent 120 minutes, whereas 18% spent less than 30 minutes (M = 70.52; SD = 58.78). Overall, participants indicated that they spent time on blogs between 5 to 6 hours during a week (M = 343.05; SD = 317.40). Most of participants used blogs at home (89.2%), followed by Internet café (4.5%), and school (3.4%).

Measurement

Blog motives. Blog motives were operationalized as the reasons why people used blogs. To solicit exhaustive reasons, the open-ended question, *"I use blogs because…,"* asked participants to write three reasons why they used blogs. Then, the reported reasons for using blogs were categorized through content analysis.

Blog usage. Five items were developed to measure the most visited blog, length of use, duration of time spent on blogs, and a place for blog access. The first item asked about the blog that they used the most, followed by three questions of "*how long have you used blogs?," "how much time do you use blogs each time?,"* and *"how much time do you use blogs in a week?"* The last question was to specify a place where participants usually used blogs (i.e., home, school, workplace, Internet café, and others).

Results

Research Question 1 was to explore motives for using blogs. Content analysis was conducted to develop categories that emerged from the reported reasons.

All participants (N = 268) reported their first reason of why they used blogs, whereas 83.9% and 54.5% of participants reported their second and third reasons, respectively. A total of 493 reported reasons were analyzed by two coders to develop categories of blog motives emerged from the qualitative data.

According to Dillard (1989), content analysis of the reported reasons for using blogs was conducted based on two criteria: clarity and content. The reported reasons that were not clearly stated or were not relevant to blog motives were excluded. Two coders independently analyzed a random sample of about 20% of the reported reasons. Through discussions, seven blog motives emerged: (1) relationship maintenance, (2) new friendship, (3) self-expression, (4) entertainment, (5) passing time, (6) trend, and (7) social influence (see Table 1).

Table 1

Categories of Motives for Using Blogs

Motive Categories	Reported Reasons *n* (%)	Examples
Relationship maintenance	168 (34.1)	To talk with friends, to meet old friends
Self-expression	111 (22.5)	To update pictures, to check comments
New friendship	71 (14.4)	To make friends, to know other people
Entertainment	48 (9.7)	To play a game, to have fun
Social influence	24 (4.9)	To follow my friends
Passing time	15 (3.1)	To kill my time, have nothing to do
Trend	8 (1.6)	To be in trend

Notes. $N = 268$.
The total number of reported reasons was 493. Forty-eight reported reasons (9.7%) were not classified using the seven motive categories.

After obtaining the seven categories of the blog motives, the two coders independently analyzed the reported blog reasons. Approximately, 90.3% of the entire blog reasons could be classified into the seven categories. The reposted reasons that were not classified into any motive categories were such as "*to improve my computer skills," "my teacher asked me to create one,"* and *"to save cost for communicating with friends."* Based on a random sample of 20% of the data, the intercoder reliability assessed by Scott's (1955) *pi* was .92.

Then, the seven blog motive categories were verified for their statistical existence. Several statements from the participants' responses were selected to represent each blog motive and developed into a 5-point Likert scale for factor analysis in Study 2.

STUDY 2

Sample

Participants ($N = 215$) were undergraduate students who currently enrolled in classes at the large international university in Thailand. Nineteen responses were discarded and then resulted in a final sample of 196 participants. Thirteen participants had not used blogs in the past three months, and six participants did not complete the questionnaire. Participants were asked to indicate their reasons for using blogs on Likert-typed questions and responded to the questions about blog usage and demographics similar to those in Study 1.

Participants were 118 females (60.2%) and 78 males (39.8%). They were ranged in age between 17 and 26 ($M = 20.17$ years old; $SD = 1.60$). Forty-two participants (21.4%) were

freshmen, 73 participants (37.2.5%), 34 participants (17.3%), and 47 participants (24.0%) were sophomore, junior, and senior students, respectively.

Again, a majority of participants (74.0%) reported *Hi5* as the blog that they used the most, 11.7% and 7.7% mostly used *Facebook* and *YouTube*, respectively. *MySpace* was accessed the least. Also, participants had used blogs for less than 2 years (M = 17.18 months; SD = 12.32). About 22.4% of participants had used blogs for 12 months, 19.0% had used blogs for 24 months, and 8.6% had used blogs for 36 months.

About 31.4% of participants spent time between 61 to 180 minutes on blogs each time while 19.5% and 28.1% spent 30 minutes or 60 minutes, respectively (M = 89.52; SD = 71.68). Overall, participants indicated that they spent time on blogs about 7 hours during a week (M = 424.51; SD = 436.92). Most of participants used blogs at home (92.9%) while some accessed to blogs at school (2.6%).

Measurement

Blog motives. The scale measured a degree to which people rated their own reasons for blogging similar to the seven blog motives. The final blog motive scale consisted of 25 items on a 5-point Likert scale ranging from *Not at All* (1) to *Exactly* (5) like one's own reasons for using blogs. For example, the items were: *I use blog*… "*to chat with my friends anytime," "to find new friends," "because I have nothing to do,* and *"because my friends have it."*

Blog usage. The five items asking about participants' blog usage patterns were similar to those used in Study 1. The items measured the most visited blog, length of use, duration of time spent on blogs, and a place for blog access.

Results

Study 2 had two purposes. The first purpose was to quantitatively analyze blog motive factors that emerged from Study 1. The second purpose was to answer Research Question 2 asking how motives predicted blog use.

Blog motive structure. Factor analysis was conducted to further verify the existence of the seven blog motives: relationship maintenance, self-expression, new friendship, entertainment, social influence, passing time, and trend. All 25 items were computed in principal component analysis with varimax rotation. A factor was retained based on the .60/.40 rule and when an eigenvalue was greater than 1.0. The factor analysis generated five factors that accounted for 68.88% of the total variance with 19 items retained (see Table 2). Six items were not loaded on any factors and then were discarded. As a result, two blog motives of entertainment and trend were excluded. Factor analysis generated a five-blog motive structure.

Motives 1: New friendship, accounted for 34.94% of the total variance (eigenvalue = 6.64). This factor reflected blogging because the user wanted to build new relationships. All four items were loaded on the factor as expected (Cronbach α = .88).

Table 2

Factor Loadings for Blog Motives

Scale Items		Factor Loadings				
		1	2	3	4	5
Motive 1: New friendship	(α = .88)					
To make friends.		.65	.37	.13	.20	.22
To meet new people.		.73	.34	.14	.12	.14
To learn about new people and culture.		.79	.04	.09	.10	.10
To find new friends.		.76	.39	.11	.09	.14
Motive 2: Relationship maintenance	(α = .82)					
To communicate with friends.		.11	.80	.17	.18	.08
To chat with my friends anytime.		.11	.67	.32	.14	.17
To contact old friends.		.24	.67	-.04	.20	.14
To keep in touch with close friends.		.06	.74	-.00	.20	.36
Motive 3: Passing time	(α = .82)					
Because I have nothing to do.		-.04	.02	.77	.19	.05
Because I am bored.		-.05	.04	.81	.16	.07
Because I have free time.		.10	.15	.81	.09	.22
To make me relax		.34	.15	.65	-.00	.29
Motive 4: Social influence	(α = .76)					
Because my friends want me to use it.		-.02	-.12	.21	.66	.13
Because my friends have it.		.22	.26	.14	.73	-.03
Because I follow my friends.		.18	.17	.01	.78	.10
Because my friends invited me.		.05	.16	.06	.69	.19
Motive 5: Self-expression	(α = .76)					
To see others' pictures and comments.		.24	.28	.17	.09	.61
To post my pictures.		.28	.08	-.03	.20	.73
Because it is popular.		.11	.12	.29	.07	.73
Mean		2.87	3.85	3.42	3.18	3.37
SD		1.03	.86	.94	.84	.95

Notes. $N = 196$.
Means were computed from a 5-point scale ranging from *Not at all* (1) to *Exactly* (5) like the participants' own reasons for using blogs.

Motive 2: Relationship maintenance, accounted for 10.68% of the total variance (eigenvalue = 2.03). This factor reflected blogging because the user wanted to contact and communicate the person with whom they already had the relationship such as old friends and close friends. All four items were loaded on the factor as expected (Cronbach α = .82).

Motive 3: Passing time, accounted for 9.04% of the total variance (eigenvalue = 1.72). This factor reflected blogging because the user wanted to relax or enjoy their free time. Three items yielded factor loadings as expected, and one item of the entertainment factor was loaded additionally (Cronbach α = .82). The item of "to make me relax" was aligned with the motive of passing time rather than with the entertainment.

Motive 4: Social influence, accounted for 8.38% of the total variance (eigenvalue = 1.59). This factor reflected blogging because the user was motivated by their friends. All four items generated factor loadings as expected (Cronbach α = .76).

Motive 5: Self-expression, accounted for 5.85% of the total variance (eigenvalue = 1.11). This factor reflected blogging because the user posted visual/textual information to present and express himself/herself to others. Only two items showed factor loadings as expected, and one item of the trend factor was loaded additionally (Cronbach α = .76). The item of "because it is popular" represented the motive for self-expression rather than for trend.

In summary, the results from factor analysis were different from those of content analysis. Seven motive categories emerged from content analysis, whereas five motive factors were derived from factor analysis. Entertainment and trend were not motives for blogging. In Study 1, the top three reasons why participants used blogs were to maintain the relationship, to express self, and to find new friends. However, the most three salient motives for blogging in Study 2 were to maintain the relationship (M = 3.85, SD = .86), to pass time (M = 3.42, SD = .94), and to express self (M = 3.37, SD = .95), respectively

Motives as predictors of blog use. Research Question 2 asked how blog motives predicted blog use. Hierarchical regression analyses with stepwise method were conducted to examine how the five bolg motives predicted blog usage in terms of length of blog use, and duration of time spent on blogs each time and weekly.

The linear combination of the five blog motives did not significantly predict the length (months) that participants had used blogs. Based on the correlations, two of five motives (relationship maintenance and self-expression) were positively related to length of blog use (see Table 3). However, only relationship maintenance tended to be a significant predictor of length of blog use R^2 = .08, $F(1, 172) = 14.24$, $p < .01$. It alone accounted for all 8% of the variance of length of blog use, whereas the other four blog motives did not contribute to the variance at all.

The linear combination of the five blog motives did not significantly predict the duration (minutes) that participants had spent time on blogs each time. Similarly, among the five blog motives, only new friendship was a significant predictor of how much time participants spent on blogging, R^2 = .03, $F(1, 183) = 5.09$, $p < .05$, indicating that approximately 3% of the variance of the duration of blog use each time was accounted for by the motive to have new friendship. Other blog motives did not generate an additional variance.

Table 3

Bivariate and Partial Correlations of the Five Blog Motives with Blog Use

Predictors	Correlation between each motive predictor and blog use	Correlation between each motive predictor and blog use controlling for all other predictors
	How long have used blogs (months)	
New friendship	.04	.09
Relationship maintenance	.28**	.28**
Passing time	.05	.09
Social influence	.07	.05
Self-expression	.19*	.04
	How much time spent on blogs each time (minutes)	
New friendship	.17*	.17*
Relationship maintenance	.06	.00
Passing time	.11	.07
Social influence	.04	.02
Self-expression	.14	.07
	How much time spent on blogs in a week (minutes)	
New friendship	.22**	.14**
Relationship maintenance	.24**	.08
Passing time	.29**	.23**
Social influence	.07	.06
Self-expression	.22**	.08

* $p < .05$, ** $p < .01$

The linear combination of the two blog motives significantly predicted the duration (minutes) that participants had spent time on blogs in a week, $R^2 = .09$, $F(2, 180) = 10.19$, $p < .01$, accounted for approximately 9% of the variance of the duration of blogging weekly. Although four of five motives, excepting social influence, were positively related to duration of weekly blog use (see Table 3), only new friendship, $R^2 = .02$, $F(1, 180) = 4.06$, $p < .05$, and passing time, $R^2 = .07$, $F(1, 181) = 16.04$, $p < .01$, were significant predictors of time participants spent on blogs weekly. Passing time was a stronger predictor explaining 7% of the variance, whereas new friendship contributed only an additional 2% of the variance.

Overall, two motives, social influence and self-expression, did not significantly influenced any blog use while the other three motives of relationship maintenance, new friendship, and passing time were significant predictors. Participants who were motivated to maintain existing relationship with friends were more likely to use blogs for a longer period time. The more they wanted to contact and communicate with long-time friends, the longer they have used and participated in blogs. Moreover, participants tended to stay longer in blogs each time when they wanted to find and build new relationship with others. When analyzing

blogging in a week, participants tended to spend more time in blogs to seek new friendship as well as to pass time.

Gender differences. Additional analyses were performed to investigate differences between males and females in blog motives and use. An independent-samples *t* test indicated significant differences in one blog motive, relationship maintenance, $t(194) = 8.46$, $p < .01$. Females ($M = 4.03$; $SD = 0.71$) tended to be motivated to maintain relationship through blogging than did males ($M = 3.58$; $SD = 1.00$).
Furthermore, independent-samples *t* tests showed significant gender differences in blog use on duration of blogging each time, $t(183) = 7.22$, $p < .01$, and in a week, $t(181) = 4.57$, $p < .01$. Females spent more time on blogs each time, ($M = 99.62$ minutes; $SD = 75.77$), and during a week, ($M = 467.46$ minutes; $SD = 465.56$) than did males, ($M = 74.72$ minutes each time; $SD = 62.81$), ($M = 362.67$ minutes weekly; $SD = 386.69$).

DISCUSSION AND IMPLICATIONS

Blog Motivation

As more and more people turn to blogs as a new medium to communicate with others, we begin to question why blogs is widely accepted, how people use blogs, and whether blogs are comparable to or even better than other traditional and online media. This study is one among other prior research to answer these questions through a different approach using qualitative and quantitative methods.

Content analysis unfolded seven blog motives emerged directly from the participants' self-reported reasons. Factor analysis produced a five-motive structure of blog motivation similar to those seven motives – new friendship, relationship maintenance, passing time, social influence, and self-expression. However, entertainment and trend were not loaded as independent factors. Probably, a blog motive to pass time partly includes entertainment, indicating by one item *"to make me relax"* incorporated with passing time instead of entertainment. Past research show inconsistent findings about trend as a blog motive (Huang et al., 2008; Jung et al., 2007). In this study, one item *"because it is popular"* was included in self-expression rather than in a trend motive as expected. Using blogs to be in new trend may be represented by posting and updating visual and textual information on blogs as others do.

Motivation as Predictors of Blog Use

A combination of the five blog motives did not predict blog use. However, new friendship, relationship maintenance, and passing time were significant predictors of blog use in different ways. The more participants wanted to build or maintain relationship with others, the more they stayed and spent time longer in blogging. The results are consistent with the literature based on a social networking perspective showing that pre-existing social ties attracted bloggers to remain active (Lento et al., 2006). The implication reflects in the questions whether and how these motives are similar to or different from those of other media. The findings contribute to U&G as a theoretical framework to explain that people are motivated and goal-oriented in selecting media to gratify needs. Bloggers are influenced to use blog by the three significant blog motives – new friendship, relationship maintenance, and passing time. These blog motives represent interpersonal motives that also serve as motives for using

certain media such as VCR (Rubin & Bantz, 1989) and mobile phone (Dumrongsiri & Pornsakulvanich, 2008). Perhaps, people may have a similarly primary set of motives that lead to different media use. A synthesis of prior research on motives of various media is essential to help clarify this speculation.

Passing time was the strongest predictor of blog use. The more participants wanted to kill their free time, the longer hours they spent on blogging. Based on U&G, the finding implies that Thai adolescents may perceive blogs as a functional alternative for passing time. This notion provides a caution to a concerned party such as parents, practitioners, scholars, and government to promote blog use in a more productive way.

Lastly, social influence and self-expression did not predict any blog use. Blogging demands much effort and commitment from users to remain active. Thus, bloggers are to be self-motivated to participate and spend time in blogs. Social influence reflects an external motive produced by others. When compared to the three significant blog motives, they tend to represent self-driven motives to seek new friends, maintain contact with existing friends, and pass their free time. Possibly, people may not be willing to spend more hours in blogging if they are not motivated by themselves to perceive blog as a functional alternative to other media. Also, self-expression reflects a self-oriented motive to express and present personal profiles. On the other hand, the three significant motives seem to characterize socialization motives to interact with friends and others. Socialization requires a longer time spending in blogs to learn, share, and exchange information than self-expression.

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SUPPLY CHAIN MANAGEMENT PRACTICES: ITS LINKAGE TO FIRM'S SALES

Za'faran Hassan, Faculty of Business Management, Universiti Teknologi Malaysia.
zafaran@salam.uitm.edu.my
Arawati Agus, Graduate School of Business, Universiti Kebangsaan Malaysia
(araa@ukm.my)

ABSTRACT

As global competition increases, businesses should be more involved in how their suppliers and customers do business. The process of making and distributing products and services to customers is becoming the most effective and efficient way for businesses to stay successful and is central to the practice of supply chain management. This paper examines the relationship between supply chain management programs and sales in Malaysia firms. Production manager's perception of SCM practices and sales in the industry were analyzed using Spearman's correlations, Friedman's rank test and multiple regression analysis. The findings suggest that SCM practices and implementations have significant correlations and associations with sales. The result also indicates that 'High sales-generated companies' emphasized more on SCM practices such as 'Customer Relations Practices', 'Technology and Innovation' and 'Strategic Supplier Partnership'. Thus to compete successfully in today challenging business environment companies should be able to effectively integrate the internal functions within a company and effectively linking them with the external operations of suppliers and supply chain members

Keywords: Supply Chain Management, Sales, Manufacturing Companies and Multiple Regression Analysis.

INTRODUCTION

Supply chain is often described as a process linking individual business units from the source of supply through value adding intermediaries such as manufacturing and services to the final customer; so that flow of material, information and money can be effectively managed to meet business requirements. The success of SCM requires planning, managing and controlling flows of material, information, ownership and payment through the integration of key processes, from original suppliers through all the echelons of the supply chain which ultimately produce values to the consumers. If there is a problem in one business unit, the problem consequently causes other problems in other areas and weakens the effectiveness of the whole supply chain. As global competition increases, businesses should be more involved in how their suppliers and customers do business. The process of making and distributing products and services to customers is becoming the most effective and efficient way for businesses to stay successful and is central to the practice of supply chain management. They need to focus on process that has an impact on enhancing supply chain management processes such as where materials come from, how their suppliers' products are designed and assembled, how products are transported and stored and what consumers really wants. The Malaysian manufacturing industry has played an important role in the development of consumers' products and contributed major portions of the national export. Increasing global competition, the demands of customers for higher product quality, greater product selection, and better customer service, the desire of firms to shrink their supply bases while striving to

contain costs, and the rising costs of natural resources today have led many Malaysian manufacturing companies to adopt cooperative, mutually partnership strategies with suppliers, distributors, retailers, and other firms within their supply chains improve profitability and overall firm sales. This study explores the possibility of adopting SCM as the basis for enhancing sales in manufacturing companies in Malaysia. It also determines the correlations between SCM and sales, and the results are then discussed and implications highlighted.

LITERATURE REVIEW

Supply Chain Management (SCM)

Supply Chain Management (SCM) is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 1998). According to Ganeshan and Harrison (1999), a supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply Chain management has the potential to assist the organization in achieving both cost and a value advantage (Christopher, 1998). To gain competitive advantage, organizations have to adopt Supply Chain Management (SCM) approach and consider the supply chain as a whole. Many researchers claim that Supply Chain Management can result in better supply chain sales (Christopher, 1998; Christiansee & Kumar, 2000), but very few empirical studies have been carried to investigate the impact of SCM on sales in Malaysian manufacturing companies.

Adopting the supply chain management concept, Kannan et al.'s (1998) study indicated that establishing efficient supply chain management practices enables an organization to enhance its Customer Satisfaction and performance, and therefore to strengthen its competitive superiority. Buxmann et al. (2003) also identified the positive influence of the suppliers' cooperation on the performance of the supply chain. Fundamentally, SCM involves integration, co-ordination and collaboration across organizations and throughout the supply chain. Supply Chain Management seeks to enhance sales by closely integrating the internal functions within a company and effectively linking them with the external operations of suppliers and chain members. Supply Chain management requires coordination with customers and suppliers. Firms must achieve a relatively high degree of integration before implementing SCM.

In recent years the benefit of supply chain has evolve to enhance customer relationship and customer satisfaction. Hammer, (2007) support the case that supply chain management will undeniable increase customer satisfaction. Supply chain management (SCM) has been a major component of competitive strategy to enhance organizational productivity and profitability (Gunasekaran, Patel, & McGaughey, 2004). Supply chain is also an important element in logistics development for all industries. It can improve efficiency and effectiveness of not only product transfer, but also information sharing between the complex hierarchies of all the tiers. Eventually this will lead to sales and business performance. Many supply chain organizations, nevertheless, have yet to translate their awareness of new opportunities for supply chain improvement into action. Others are struggling to fully adopt and realize the promised capabilities due to measurement difficulties. (Pauler, Trivedi, & Gauri, 2009).

Performance Measurement in SCM

The process of choosing appropriate supply chain performance measures is difficult due to the complexity of these systems (Beamon, 1999). In recent years there has been a expansion of approaches to performance measurement across a range of disciplines, including management accounting, operations management, marketing, human resource management (HRM) and corporate strategy (Chenhall & Langfield-Smith, 2007). The study has demonstrated how many disciplines have contributed to the development of performance measures. Performance management has drawn insights by combining a financial perspective with a non-financial marketing orientation to develop further our understanding of the linkages between customer loyalty, customer satisfaction and financial performance. The more mature and well integrated the supply chain, the better its cost and profitability performance (Roloff, Gailius, Ibarra, & Polese, 2001).

In small firms, efficient SC integration may play a more critical role for sustainable performance improvement, while, in large firms, the close interrelationship between the level of SCM practices and competition capability may have more significant effect on performance improvement (Soo Wook, 2006). Therefore, in early stage, the emphasis on systemic SC integration may be more crucial. Once SC integration has been implemented, it may be advisable to focus on SCM practice and competition capability. Although the potential benefits for integrating supply chains are compelling the barriers to success can be daunting. Understanding these barriers can lead to designing bridges to allow companies to obtain SC benefits (Fawcett, Magnan, & McCarter, 2008). The study highlights that technology, information, and measurement systems as major barriers to successful supply chain collaboration which can halt the organization sales performance. Fawcet et al. (2008) also acknowledge that people are the key bridge to successful collaborative innovation and should therefore not be overlooked as companies invest in supply chain enablers such as technology, information, and measurement systems.

INDEPENDENT CONSTRUCT MEASUREMENT: VALIDITY AND RELIABILITY

Validity and reliability tests were used to select and assess the final items of the independent constructs that would be used for statistical testing. Content validity represents the sufficiency with which a specific domain of content (construct) was sampled (Nunnally, 1978). Content validity is subjective and judgmental but is often based on two standards put forward by Nunnally: does the instrument contain a representative set of measures, and were sensible methods of scale construction used (Flynn et al, 1990, 1995). The critical variables of supply chain management in this study had content validity because an extensive review of the literature was conducted in selecting the measurement items and the critical factors, and all the items and factors were evaluated and validated by professionals in operation management areas. The SCM variables in this study were adopted from prominent studies or sources (Gunasekaran et al, 2003, Kuei et al., 2001, Li et. al, 2002, Hill, 2003, and Vickery, 1999).

In this study, SCM measurements was operationalized based on seven different kinds of programs that manufacturers commonly used to integrate their operations with suppliers and customers namely Strategic Supplier Partnership, Customer Relations Practices, Information

Sharing, Quality Information Exchange, Lean System, Postponement Concept and Technology & Innovation. One of the foundations of SCM is **Strategic Supplier Partnership**. Suppliers can provide benefits to the manufacturing company and the entire supply chain. They also can gain benefits from these relationships in term of long-term and high-volume sales. In addition, **Customer Relations Practices** or customer relations management involves activities such as how to meet delivery due dates, how to resolve customer complaints, how to communicate with customers, and how to determine the distribution services required. Simultaneously, when there is a high degree of trust, **Information Sharing** system between SCM partners can be customized to serve each other more effectively. However, confidentiality of sensitive financial, product, and process information must be maintained. In addition, **Quality Information Exchange** is also crucial in SCM and factors that are important are related to the timely, accurate, complete and adequate information. On the other hand, **Lean System** is related to activities such as reducing setup time, continuous improvement programs, pull production system, shorter lead times, streamlined paperwork and small lot size. Further, **Postponement Concept** is a principle for a manufacturing company to constantly keeping product standardized in the process to minimize complexity. Lastly, **Technology & Innovation** enables companies to achieve competitive advantage in terms of both lower cost and faster service by applying modern and updated technology (Davis & Heineke, 2005 pp 80; Wisner et al., 2005 pp 13, 15, 64, Li et al., 2002).

In the initial stage of the data analysis, the seven SCM variables constructs were subjected to validity and reliability tests before a single score can be calculated to represent each construct. Multi item scales were developed for each construct in the study. Before creating the final scales, the data were checked for normality and outliers. Next, confirmatory factor analysis (CFA) or a measurement model using AMOS 4 was employed for examining construct validity of each scale by assessing how well the individual item measured the scale (Ahire, Golhar and Walter 1996). Specifically, confirmatory factor analysis was used to detect the unidimensionality of each construct. Unidimensionality is evidence that a single trait or construct underlie a set of measures (Hair et al. 1988). The measurement model for each construct was treated as a single factor congeneric model with error variances and estimated regression weights. According to Motwani et al. (1997), to establish the construct validity of the measure, it is crucial to determine (1) the extent to which the measure correlates with other measures designed to measure the same thing and (2) whether the measure behaves as expected. The goodness of fit indices (GDI) of the seven SCM constructs exceeded the 0.90 criterion suggested by Hair et al. (1998), hence, establishing the construct validity. CFA showed all the items were loaded highly on their corresponding constructs, which supported the independence of the constructs and provided strong empirical evidence of their validity. Divergent or discriminant validity was tested by analyzing bivariate correlations between each of the SCM scales and other variables such as demographic variables and company size etc. There were no significant correlations between the SCM variables and these variables, and thus the scales were not measuring other unintended constructs. Since data for this study was generated using scaled responses, it was deemed necessary to test for reliability (Frohlich & Westbrook, 2001).

TABLE 1 Descriptive Statistics of Critical Variables of SCM Programs.

Variable	Original items	Final items	Mean	Std. Dev.	Reliability
Strategic Supplier Partnership	8	8	5.247	0.871	0.801
Customer Relations Practices	7	7	5.704	0.836	0.826
Information Sharing	4	4	4.888	1.215	0.911
Quality Information Exchange	4	4	5.250	0.925	0.908
Lean System	6	6	5.329	0.905	0.808
Postponement Concept	6	6	5.346	0.824	0.822
Technology and Innovation	6	6	5.230	1.088	0.918

The reliability analysis was conducted by calculating the Cronbach's alpha for each construct. Items that did not significantly contribute to the reliability were eliminated for parsimony purpose. The result shows that the Cronbach's alpha measures for the seven constructs exceeds the threshold point of 0.70 suggested by Nunnally (1978). Alpha coefficients for SCM scales range between 0.801 and 0.918 after the alpha maximization process were carried out (Table 1). As a result, 41 items were retained for the seven constructs.

DEPENDENT CONSTRUCT MEASUREMENT

Several studies have identified performance improvement constructs that are commonly associated with SCM (Voss, 1988, *Gunasekaran et al, 2003, Kuei et al., 2001 and Cox, 1999*). Voss (1988) classified performance measures into three groups: market place competitive advantage, productivity increases, and non-productivity benefits. Marketplace success involved longer-term competitive gains including increased sales. In this study, the performance variable, sales is determined from a single dimension measurement using 7-point interval scale. Items in the instrumentation for sales performance, include such aspects relating to sales revenue growth, sales growth, market share, return on sales and customer relationship management

TABLE 2 Descriptive Statistics Of Performance Variable

Indicator	**Mean**	**Std. Dev.**	**Reliability (Cronbach Alpha)**
Sales	4.8257	1.246	Single dimension measurement

RESEARCH METHODOLOGY

The instrument used in this study was a structured survey questionnaire, which was designed to assess the companies in term of the described dimensions. The instrument developed in this study consists of two major parts. The first part comprises several constructs measuring SCM practices, and the second part comprises performance (sales). To enable respondents to

indicate their answers, seven–point interval scales were use for SCM variables. A total of seven constructs of SCM, which have been widely referred, were extracted. Similarly, the dependent variable namely sales also used a seven-point interval scale, representing a range of agreement on statement whether over the past three years sales are high relative to competitors after implementing SCM practices.

Sample companies were randomly chosen from manufacturing companies in Klang Valley, Malaysia. Companies in Klang Valley were chosen because majority of these companies were situated in Klang Valley (mostly in Kuala Lumpur and Selangor). The reasons for focusing on this sector are twofold. First, manufacturing companies have emerged as leading sectors in Malaysia in terms of adopting new manufacturing and SCM programs and these practices are driven primarily by competitive rather than regulatory forces. Second, the industry is heterogeneous in terms of sub-sectors and product/process complexity. Hundred and ten (110) useable responses were received and were analyzed using the SPSS package. The primary purpose of the research was to measure senior quality managers' or production manager's perception of SCM variables and to gain insight into the benefits of implementing SCM in the manufacturing industry. The goal is to understand and determine determinants of SCM that can improve sales. Face to face interviews with SCM managers or production managers were carried out for checking the information accuracy, validating the outcome of analysis and developing an understanding of practical aspects of SCM principles adoption. Given the scarcity of OR research in Malaysia that examines associations between SCM and performance, the purpose of this paper is to enhance managerial understandings of SCM and sales by addressing the following questions:

a) Which SCM programs have significant impact on sales?

With regards to these questions, the main objectives of this paper are:

1) To empirically investigate correlates between SCM and sales.
2) To empirically assessing the importance of each SCM indicator on sales.

STUDY FINDINGS

Discussion on the empirical findings will be based on several statistical analyses which include (a) Pearson correlation analyses, (b) Friedman's rank test and (c) Stepwise multiple regression analysis.

(a) Pearson Correlation analyses between SCM programs and sales

Pearson correlation (Table 3) is conducted to investigate and describe relationships between SCM and sales. This result indeed confirms close associations between SCM programs and sales. Sales has positive and strong correlations with Technology and Innovation (r = 0.486), Customer Relations Practices (r = 0.464), Lean System (r = 0.449), and Strategic Supplier Partnership (r = 0.431). In addition, it also has significant correlations with Lean System (r = 0.449), Information Sharing (r = 0.423) and Postponement Concept (r = 0.422). These findings are consistent with several previous studies that proclaimed better organizational transformations as a result of SCM initiatives (Lee et al., 1997; Metters, 1997; Narasimhanand Jayaram, 1998; Lummus et al., 1998; Anderson and Katz, 1998). Fundamentally, to improve sales, a manufacturing company should implement SCM programs.

TABLE 3 Spearman's Correlations Between Supply Chain Management Programs And Sales

Supply Chain Management programs		**Sales**
1	Strategic Supplier Partnership	0.431(**)
2	Customer Relations Programs	0.464(**)
3	Information Sharing	0.423(**)
4	Quality Information Exchange	0.432(**)
5	Lean System	0.449(**)
6	Postponement Concept	0.422(**)
7	Technology and Innovation	0.486(**)
*P≤0.05, **P≤0.01 2. All t-tests are one-tailed		

(b) Cluster Analysis and Friedman's Test

To further explore on the segmentation of manufacturing companies in this study, a cluster analysis was carried out. Since sales is a very importance bottom-line outcome, therefore the classification is based on sales clustering. The result from cluster analysis statistically segmented the manufacturing companies into two clusters based on sales namely "High sales-generated companies" and "Low sales-generated companies". Tables 4 highlights further information about the cluster. The first cluster ("High sales-generated companies") comprises of large-scaled companies with average employees of more than 1,000 people and average approximated sales turnover of RM 1.5 billion. Mean while, the second cluster ("Low sales-generated companies") comprises of smaller companies with average employees of about 600 and average approximated sales turnover about RM 90 million. From the result, we can also infer that the higher level of SCM implementations are more realized in "High sales-generated companies" than "Low sales-generated companies". "High sales-generated companies" put high priorities on 'customer relations programs', 'technology and innovation', 'lean system' and 'strategic supplier partnership' followed by 'postponement concept', 'quality information exchange' and 'lastly information sharing'. On the other hand, the second cluster ("Low sales-generated companies") has high priorities on 'customer relations practices', 'postponement concept' and 'strategic supplier partnership'.

TABLE 4 Rankings Of Supply Chain Management Programs Based On High And Low Sales-Generated Companies Using Friedman's Test

Supply Chain Management programs	High sales-generated companies (n=63, chi-square = 51.358, significant=0.000)				Low sales-generated companies (n=47, chi-square = 18.717, significant=0.005)			
	Friedman's Test	Rank	Mean	Std Dev	Friedman's Test	Rank	Mean	Std Dev
Strategic Supplier Partnership	4.22	3	5.644	1.0131	4.22	3	4.7805	1.12943
Customer Relations Programs	5.10	1	5.966	.87032	4.85	1	5.0976	1.06782
Information	2.81		4.924	1.4318	3.28		4.1951	1.29845

Sharing		7				7		
Quality Information Exchange	3.32	6	5.203	1.2633	3.52	6	4.5000	.96825
Lean System	4.19	4	5.525	1.2192	4.15	4	4.7317	1.02529
Postponement Concept	4.11	5	5.551	1.0115	4.34	2	4.8293	.89170
Technology and Innovation	4.24	2	5.559	1.3166	3.63	5	4.4390	1.07352

DETERMINING THE RELATIONSHIP BETWEEN SCM PRACTICES AND SALES: A STEPWISE MULTIPLE LINEAR REGRESSION ANALYSIS.

In this study, a multiple regression analysis was used to investigate the relationship between a set of predictor variables and a dependent variable and to identify most contributing SCM programs determinants. The model developed represents an attempt to account for the contributions of critical determinants of SCM programs on sales.

Testing the Overall Regression Model

A regression forecasting model is generated as follows:

$$Y = Y_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + ...\beta_i X_i + e,$$

where:

$x_1, x_2 .....x_i$ -– independent variables

$\beta_1, \beta_2 .....\beta_i$ – regression coefficients for the respective independent variables, $x_1, x_2 .....x_i$

The overall significance of the multiple regression model is tested with the following hypotheses:

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 .... \beta_i = 0$

H_a : At least one of the regression coefficients is $\neq 0$.

A rejection of the null hypothesis indicates that at least one of the predictor variables is adding significant predictability for the overall sales. The multiple regression result using stepwise method (Table 5) indicates that a strong relationship existed as hypothesized. This model has a good fit and significantly high values of R (0.623) and R^2 (0.388). The value of R^2 represents the proportion of variation of the dependent variable, Y, accounted for by the independent variables in the regression model. Meanwhile, R value indicates strong association between the independent and dependent variable. The value of adjusted R^2 is 0.369 with standard deviation of 0.9499 and a significant F-value of 20.117. The model exhibited a significant F value. The F test was used to determine if the research model was able to account for a significant amount of variation in the dependent variable (Black 2001). The regression model suggests that SCM Programs are able to explain almost 40% of the variance in the dependent variable (sales). This value is considered quite high, given that a multitude of factors affecting sales.

TABLE 5: The Regression Model Summary

R	R^2	Adjusted R^2 (Adj. R^2)	Std Error (SE)	*F*	Sig
0.623	0.388	0.369	0.9499	20.117	0.000

Significance Tests of the Regression Coefficients

The significance of beta coefficients provides support for the alternative hypothesis in the regression model. The values of the standardized beta coefficients of the SCM programs determinants provide some indication to their comparative influences on sales. Individual significance tests for each regression coefficient are carried out by using a *t* test (Hair *et al.* 1995). The hypotheses for testing the regression coefficient of each independent variable take the following form:

$$H_0 : \beta_i = 0$$
$$H_1 : \beta i \neq 0 \qquad (i = 1,2,....,k).$$

TABLE 6 The relationship between SCM programs and Sales (A Stepwise regression analysis)

SCM programs	Unstd. Coeff.		Std.	t	Sig.
	Beta	S. Error	Beta		
Constant	.792	.561		1.412	.161
Customer Relations Programs	.349	.104	.303	3.363	.001
Technology & innovation	.249	.081	.280	3.074	.003
Information sharing between supply chain partners	.194	.075	.231	2.593	.011

- Dependent variable = sales.

Testing the regression coefficients not only gives researchers some insight into the fit of the regression model, but it also helps in assessing the strength of individual predictor variables in estimating Y (Black, 2001). The result (Table 6) indicates that regression coefficients or slopes of 'Customer Relations Programs', 'Technology & Innovation' and 'Information Sharing between Supply Chain Partners' have significant impact on sales. This indicates the importance of combined efforts from management, employee, suppliers and customers. Managers of manufacturing companies are responsible for synthesizing all of the different SCM processes and programs in the business into a cohesive system focused on a common set of goals. To reduce the concern for data multicollinearity that maybe due to highly correlated variables, the study further determines VIF (variance inflation factor) values of the predictor variables. However, it is safe to conclude at this point that the overall regression model has a good fit.

In this study, the regression model was tested in order to explore the relationship of the seven critical factors of SCM practices and sales. The results of the initial multiple regression

analysis was expected to provide insights into those SCM critical variables thought to be most important in upgrading the level of sales of manufacturing companies. However, future researchers should be aware of possible problems that may be encountered during regression analysis or discriminant analysis: (a) First, the problem of multicollinearity and (b) Second, the presence of outliers. Fortunately, we do not detect any outliers from the scatter diagram.

TABLE 7 Collinearity Statistics

SCM Practices	Tolerance	VIF
Strategic Supplier Partnership	0.635	1.574
Customer Relations Practices	0.793	1.260
Information sharing	0.880	1.137
Quality Information Exchange	0.851	1.175
Lean System	0.744	1.344
Postponement Concept	0.781	1.280
Technology & innovation	0.838	1.193

As stated earlier, one problem that can arise in multiple regression analysis is multicollinearity. One of the basic assumptions in regression modeling is that the independent variables in the model are not linearly related. Multicolliearity is when two or more of the independent variables of a multiple regression model are highly correlated (Black, 2001; Wang, 1996). Multicollinearity affects the stability of the parameter estimates calculated in multiple regression and discriminant analysis models. Technically, multicollinearity could lead to improper variable estimations and ultimately unstable regression models formation. The result may suggest a misleading conclusion because when independent variables are highly correlated, the t-values exhibited are insignificant. This is because when independent variables are correlated the estimated standard error of the coefficients will be large and independent variables that should be significant predictors of a dependent variable are insignificant (Agus, 2000; Wang, 1996). The t values test the strength of the predictor given the other variables in the model. If a predictor is highly correlated with other independent variables, it will appear not to add much to the explanation of Y and produce a low t value. However, had the predictor not been in the presence of these other variables, the predictor might have explained a high proportion of variation of Y (Black, 2001).

Several procedures have been suggested in the literature for detecting the presence of multicollinearity among variables (Wang, 1996). In this study, VIF_j (variance inflation factor) associated with each predictor variable X_j were determined. If one or more of these variance inflation factors are large, we can conclude that multicollinearity exist among independent variables. It has been suggested, as a rule of thumb, that values of VIF_j greater than 10.00 may be considered large enough for us to suspect serious multicollinearity problem (Graybill & Iyer 1994). Since none of the SCM variables exhibit values of VIF_j greater than 2.00, (Table 7) it is suggested that the presence of multicollinearity in this study is not severe. On the whole, the result exhibited a significant overall F test for the model, and also significance t values for predictor variables such as 'Customer Relations Programs', 'Technology & Innovation' and 'Information Sharing between Supply Chain Partners'.

CONCLUSION AND IMPLICATIONS

The purpose of this paper is to empirically test the impact of supply chain management practices on sales so as to determine to what degree SCM issues influence sales in manufacturing companies in Malaysia. In summary, the findings of the empirical study are clear, and suggest several things. Firstly, there is significant impact of SCM practices on sales of the Malaysian manufacturing companies. The findings suggest that supply chain management programs have significant correlations with sales. "High sales-generated companies" gives high emphasis on customer relations practices, technology and innovation, lean system, strategic supplier partnership followed by postponement concept, quality information exchange and lastly information sharing. Further, the findings from stepwise regression stress the importance of 'Customer Relations Programs', 'Technology & Innovation' and 'Information Sharing between Supply Chain Partners' on sales. Since customers are very important in any business, manufacturing companies need to translate customer requirements into product designs such as using a method called quality function deployment (QFD). It uses inter-functional teams to study and listen to customers to determine characteristics of superior products. In addition, advances in technology and innovation such as robotics and automation, are affecting every aspect of business which change the way manufacturing operations are being designed and managed. Lastly, successful SCM requires the sharing of information between suppliers. This information sharing can include everything from new product design specifications to capacity planning, scheduling and database in order to enhance the manufacturing process (Davis & Heineke, 2005, pp 149-150, 78, 117).

The results of this study suggest that superior adoption in SCM does have an impact on sales. The findings show that SCM is positively related to sales, which reinforces several empirical studies in the supply chain (Vickery et al. 1999, Lee et al., 1997, Frohlich & Westbrook, 2001 Gunasekaran et al, 2003, Kuei et al., 2001; and Cox, 1999). The findings of this study relate to the manufacturing industry in Malaysia. As the prominence of the service sector increases, attention is being directed to help understand the issues and complexities within "service" supply chain. It is important to highlight the differences between service supply chains and the more traditional manufacturing supply chains (Sengupta, Heiser, and Cook, 2006)) In service supply chains, human labor forms a significant component of the value delivery process and while, physical handling of a product leads to standardized and centralized procedures and controls in manufacturing supply chains, in services this is not entirely possible as many of the decisions are taken locally and the variation and uncertainties in outputs are higher because of the human involvement. In addition, the focus of efficiencies in service supply chains is on management of capacity, flexibility of resources, information flows, service performance and cash flow management. These issues are quite different from manufacturing supply chains and hence extensive examination of service supply chains is required to further understand these issues (Ellram, Tate and Billington 2004). However, there are also many areas where there are similarities. For instance, demand management, customer relationship management and supplier relationship management are critical factors in manufacturing supply chains that remain equally important in service supply chains. Thus the findings of this study may also apply to the service industry supply chain, as it relates to information sharing management, quality information exchange, and customer relations practices.

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Author's Background

Za'faran Hassan is an Associate Professor at the Faculty of Business and Management, Universiti Teknologi MARA. She obtained her BBA at Idaho State University, USA; MBA at Saint Louis University, Missouri, USA; and DBA at National University of Malaysia (UKM). She is an Associate Professor at Universiti Teknologi MARA, Malaysia. Her past administrative experience includes being the Dean of the Faculty of Hotel and Tourism Management, Director for Business Development, as well as Head of the Malaysian Entrepreneurship Development Center at her university. Currently, she is the Head of the Faculty of Business Management's Department of Management, Human Resource Management and International Business. She is an industry member for the Malaysian Productivity Corporation's Consultative Panel of Expertise for Tourism, Member of the Malaysian Institute of Management, and the Academy of International Business, as well as Associate Member of the Centre for Small Business & Regional Research (CSBRR), University of Wollonggong, NSW, Australia. She has presented papers at conferences and also published in various publications, both locally and internationallyShe is also a member of various local and international professional associations such as the Malaysian Institute of Management (MIM), Malaysian Society for Training and Development (MSTD), and the Academy of International Business (AIB). Her research interest includes areas related to Management, Strategic Management, SMEs, Entrepreneurship, Supply Chain Management and Quality Management.

Arawati Agus is a Professor of Quality and Operations Management at Graduate School of Business, National University of Malaysia (UKM). She received a Bachelor degree in Finance from Southern Illinois University and Master in Management Sciences from St. Louis University. She obtained her Ph. D. in National University of Malaysia (UKM). Her area of research includes Quality Management, Supply Chain Management, Operation Management, Service Quality and Entrepreneurship. Her works have been published in Total Quality Management (UK), International Journal of Management, Singapore Management Review, International Journal of Production Economic, Security Industry Review (Singapore), Journal of Quality and Reliability, Malaysian Management Review and Management Journal (UKM).

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MANAGING SUPPLY CHAIN NETWORK IN A GLOBALLY DISTRIBUTED ENVIRONMENT

AHM Shamsuzzoha, University of Vaasa, Finland
ahm.shamsuzzoha@uwasa.fi
Petri T. Helo, University of Vaasa, Finland
phelo@uwasa.fi

ABSTRACT

Globalized economy and increasing trends towards customized products, pushing industries to become more flexible in their product development environments. Localized production system is no longer a competitive advantage nowadays. Instead production systems are decentralized globally due to avail some benefits such as: cheaper manpower, availability of raw materials, attracts customers and so on. This decentralized production strategy influences firms to establish more and more coordination's among various suppliers internationally. For the development of products, firms rely mostly on mega-suppliers and the supply chain networks. These mega-suppliers are the real developers of technology and systems for the assemblers. These suppliers need to be communicated properly in order to ensure on time arrival of outsourced parts/components in the main assembly sites of firms. To manage these suppliers' networks is not an easy task but daunting in nature. Better communication infrastructure is required to control this huge supply networks efficiently. It is therefore, crucial to configure and coordinate complex supply chain networks for the betterment of firms. In this paper, we have demonstrated how different distributed supply chain networks can be managed properly by using software named ASDN (agile supply and demand network). For the demonstration purposes we have considered a hypothetical car engine assembly factory within Europe where different components or parts of the engine are outsourced through different suppliers within Europe. The objective of this network solution is to demonstrate how software's could be applied effectively for optimizing the decision making process in a distributed supply chain environment.

Keywords: Customization, inventory level, order decoupling point, ASDN

INTRODUCTION

The trend towards globalize economy and the revolution of electronic commerce have affected not only the end customers but also to the producers or manufacturers, distributors, retailers as well as the entire product development and distribution chains. This globalization is enabling the world to move closer to the realization of a single, borderless market and this influencing not only the businesses but also their supply chains too. The supply chain can be defined as a network of business units and facilities that procure raw materials, transform them into intermediate goods and then final products which are delivered to customers through a distribution channel (Tan and Shaw, 1998). The management of supply chain network is concerned with controlling of these activities such that the product passes through the chain with minimum time and cost (Lee and Billington, 1995). As the network of supply chain become increasingly global, coordination between processes are more critical. Nowadays the focus of supply chain management (SCM) has shifted from engineering efficient manufacturing processes to the controlling and coordination of different suppliers. This strategy helps not only information sharing among suppliers for better integration but also reduces inventory costs (Straderet al., 1998).

Global supply chain management is becoming an important issue for modern businesses with the increasing trends for globalize economy and offshore sourcing. Growing interest on decentralized business policies pushing manufacturing firms to incorporate with distributed suppliers globally rather than local or national level only. This trend is initialized due to the differences in labor costs, costs of space, tariffs, exchange rate and other expenses related to doing business overseas. Companies need to give serious attention to all of these factors before considering their global supply management approach. Firms also need to make decisions about their overall outsourcing plan and some sources need closer to home along with other countries. Other issue that must be considered before adopting the outsourcing strategy is to supplier selection. In addition, companies must make decisions about the number of suppliers to use. Fewer suppliers may be easier to manage but could also lead to potential problems if one vendor is unable to deliver as expected or if one vendor tries to leverage its supply power to obtain price concessions. All these strategies could be tradeoff for firms before making any decision process for selecting suppliers and countries.

From the beginning of industrial revolution supply chains have been viewed as simply a way to reduce costs and to get goods to the right people at the right place and in right time. Companies generally willing to implement their supply chain network in order to reduce costs, receive materials more quickly and to get products out the door on time. In such consequences, the supply chains always need some improvements in order to achieve additional benefits for companies and to drive the overall value of their business. One of these improvements may be that all vendors, suppliers, and related businesses need to be included in the supply chain. Even if one element is missing from the puzzle, then the results will never reach their maximum possible potential. Another improvement might be that the supply chain needs to be integrated with the Internet-based technology which will allow the business to work on a more global level that can further drive down prices and increase profit margins. The stability and growth of a company depend on the steady and smoother relationship among its supply network.

SHIFTING THE SOURCING STRATEGY

Traditional approach for firms to select their suppliers is simply by demanding the best price from a supplier or seeking another supplier. But this approach is day by day shifting from seek or choosing to more collaborative approach. Instead of cutting a poorly performing supplier, many firms are nowadays choosing to work with their suppliers as a partnership level in order to work more smoothly and efficiently. As supply chains become more and more global, companies of all sizes are looking for technologies and services that allow them to operate with trading partners all over the world. Collaborative capabilities would also be revolutionized through internal sales, engineering and manufacturing resources and new product designs and introductions with their geographically dispersed value chain counterparts such as; customers, partners, suppliers, etc.

To be successful in the long term, companies need to combine their capabilities across collaborative design, operational excellence, marketing and sales and efficient supply chains operations. Suppliers and manufacturers could collaborate in the design of new products, improving functionality, quality, cost and availability. From a manufacturer's perspective, suppliers should have a clear visibility into current product or service status which enabling them to better plan for technology investment and customer demand. They would have also real time awareness of supply and demand level and availability/capacity in the supply network allowing them to shift requirements between partners where appropriate. With the

visibility among suppliers and manufacturers would also be alerted them to issues needing attention throughout the value chain.

In customization era, suppliers have to have a close working relationship with the manufacturer owing to the level of customization of their products (Roethlein and Ackerson, 2004). The formal relationship between manufacturers and suppliers for specified outsourcing decisions are based on the purchasing and selling power of each others. In outsourcing principle, manufacturer communicates its quality requirements and expectations to the supplier through product specifications and through a corrective action system. The supplier needs to have a clear quality policy which focuses on change and responsiveness of products specifications for customer-focused. With active participation and collaboration between manufacturers and suppliers enhance overall product competitiveness through making innovative components or parts.

Through suppliers involvement there is a possibility of win-win outsourcing strategy. In this situation suppliers have active cooperation and participation in production networks. Supplier involvement in the production network could extend across geographic boundaries and industries for the benefits of suppliers themselves thorough economic and competitive aspects in production networks such as reliability, benevolence, altruism or reciprocity (Chung and Kim, 2003). Suppliers' involvement in production networks at the earlier development stage of products have more chances to innovate for manufacturers' components and modules compared to those in the later stage. It is assumed that suppliers involvement in the earlier stage of development learn more about new kinds of components technology and market opportunities which are essential for companies before taking decision for outsourcing strategies.

In order to compete with globalized economy, firms are adopting outsourcing policies in their product development arena (Balan et al., 2006). This outsourcing strategy puts pressure on supply chain management all over the world. Various initiatives need to take over this strategy and to stay competitive in market segment. These initiatives could be the application of software tools, executing various supply chain models and to integrated approach throughout the whole production process to make a stable and effective supply chain scenario. Before adopting outsourcing principle for various parts or components, companies need to analyze their financial viability to gain targeted profit margin as it is not so easy to turn back after used to with this strategy. And above all the integration and trust between suppliers and manufacturers are crying need to be a successful business firm. The relationships between suppliers and manufacturers are required to justify before adopting partnership dealing with suppliers or just to stay as a simple purchaser. This relationship also depends on the market growth of the suppliers, resource capabilities and possible cost savings.

DISTRIBUTED SUPPLY CHAIN: AN EXAMPLE

The following example is used to demonstrate the methodological theme of our paper. We have considered a hypothetical car engine assembly factory within Europe where different parts are outsourced and supplied by various suppliers within Europe. The BOM of the engine is shown in Figure 1 below. It is a six cylinder petrol engine and the required number of components for a complete engine is also shown within the BOM in Figure 1. For instance, it requires six pistons, six crank shafts, one cylinder head and so on.

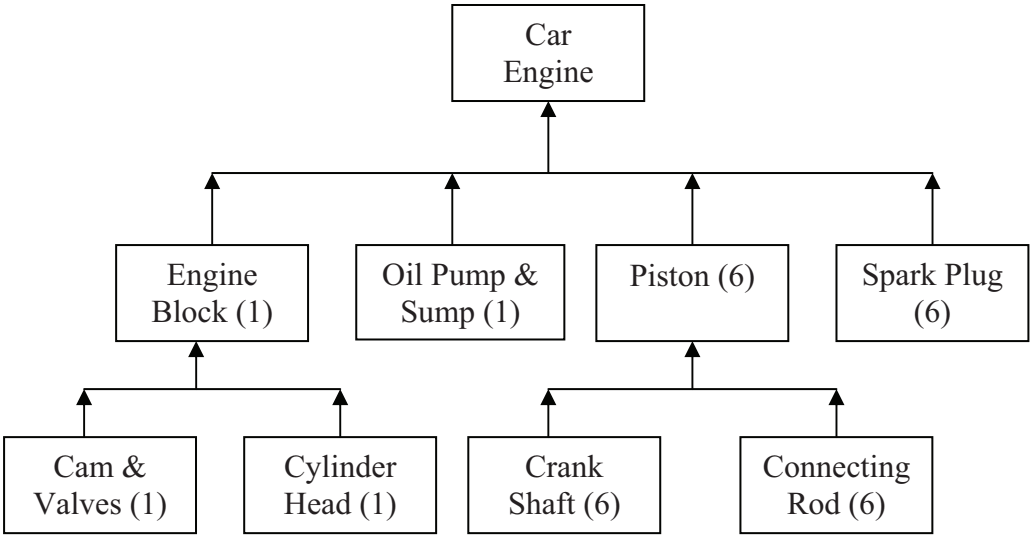

Figure 1: BOM for car engine

In order to display the network diagram and to analyze various factors such as, inventory level, cost and profit, schedule, transportation cost etc. we have used ASDN software. Different simulation results are also presented and discussed in the following paragraphs. Figure 2 below displays various suppliers, manufacturers, subcontractors, distributor and customers of the car engine. It also shows the corresponding order decoupling points such as; assembled-to-order (ATO), engineer-to-order (ETO), make-to-stock (MTS) and make-to-order (MTO).

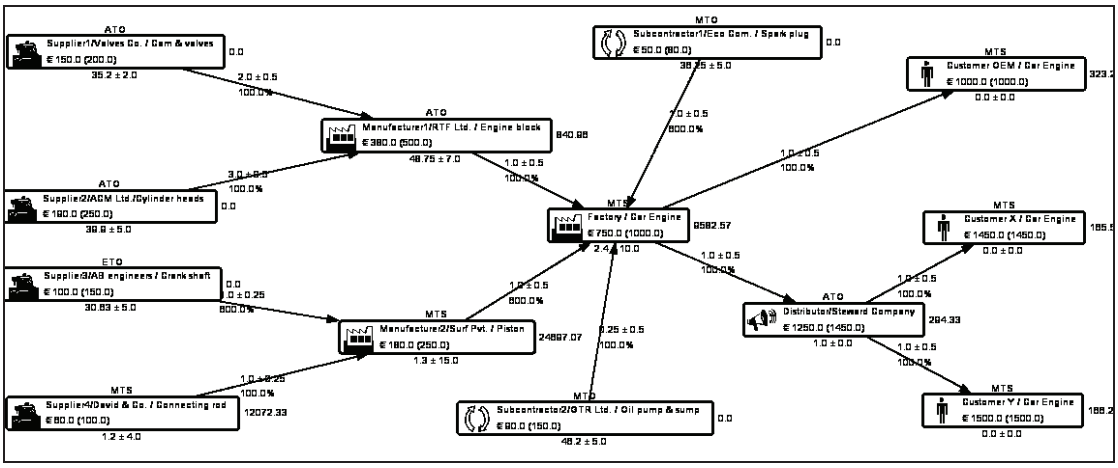

Figure 2: Supply chain network diagram

Figure 3 outlines the network view of different suppliers, manufacturers, subcontractors, distributor, customers and their corresponding countries within Europe. For instance, car engine is assembled in a factory in Germany where various parts such as; engine block is manufactured and supplied from RTF Ltd. in England, piston is manufactured and coming from Surf Pvt. in France, spark plug from subcontractor Eco Com. in Denmark and Oil pump & sump from GTR Ltd. in Italy. Four different suppliers such as; Valves Co. from Scotland and ACM Ltd. from Ireland supplies cam & valves and cylinder heads respectively to the RTF Ltd. in England for manufacturing engine block whereas AB engineers from Portugal

and David & Co. from Spain supplies crank shaft and connecting rod respectively to piston manufacturer Surf Pvt. in France. Car engines are selling to customer OEM in Sweden directly from the factory whereas customer X in Finland and customer Y in Ukraine buy engines from the distributor Steward Company in Poland.

Figure 3: Network view of supply chains with corresponding countries

RESULT ANALYSIS

The output result of the corresponding supply chain network is simulated for analytical purposes of different performance measures such as; scheduling, inventory value and level, ODP, capital tied up etc. In Table 1, information about different suppliers, manufacturers, subcontractors, distributor and customers along with supplied parts or components are displayed. In this table, different ODP for each of the companies are outlined as before optimization and after optimization. The policy for optimization was based on minimizing inventory level through changing different ODP where the constraints are to keep lead time shorter than target amount and to keep total inventory value less than target value.

In our supply chain network, we have considered lead time shorter than 153 days and total inventory value less than €48,143.00 in order to minimize inventory by changing the order decoupling points which are shown in Table 1 as before optimization. For the sake of optimization, we assumed to keep the lead time shorter than 100 days while keeping total inventory value less than €30,000.00 in order to minimize inventory by changing ODP which are shown in Table 1 as after optimization. From the table it is observed that some of the ODP is changed after optimization such as; ODP for supplier 3 (AB Engineers) has been changed from ETO to ATO after optimization and so on.

Table 1: Inventory optimization result

Company Type	Company Name	Part/Component	Decoupling point	
			Before optimization	After optimization
Supplier 1	Valves Co.	Cam & valves	ATO	ATO
Supplier 2	ACM Ltd.	Cylinder head	ATO	ATO
Supplier 3	AB Engineers	Crank shaft	ETO	ATO
Supplier 4	David & Co.	Connecting rod	MTS	ATO
Manufacturer 1	RTF Ltd.	Engine block	ATO	ATO
Manufacturer 2	Surf Pvt.	Piston	MTS	ATO
Manufacturing 3	Factory	Car engine	MTS	ATO
Subcontractor 1	Eco Com.	Spark plug	MTO	ATO
Subcontractor 2	GTR Ltd.	Oil pump & sump	MTO	MTS
Distributor	Steward Company	Car engine	ATO	MTS
Customer OEM	Customer OEM	Car engine	MTS	MTS
Customer X	Customer X	Car engine	MTS	MTS
Customer Y	Customer Y	Car engine	MTS	MTS

Figure 4 below shows the Gantt chart with required time period for corresponding suppliers, manufacturers, subcontractors and distributor. From this chart organization managers could take necessary initiatives to minimize the corresponding lead-time within the supply chain network.

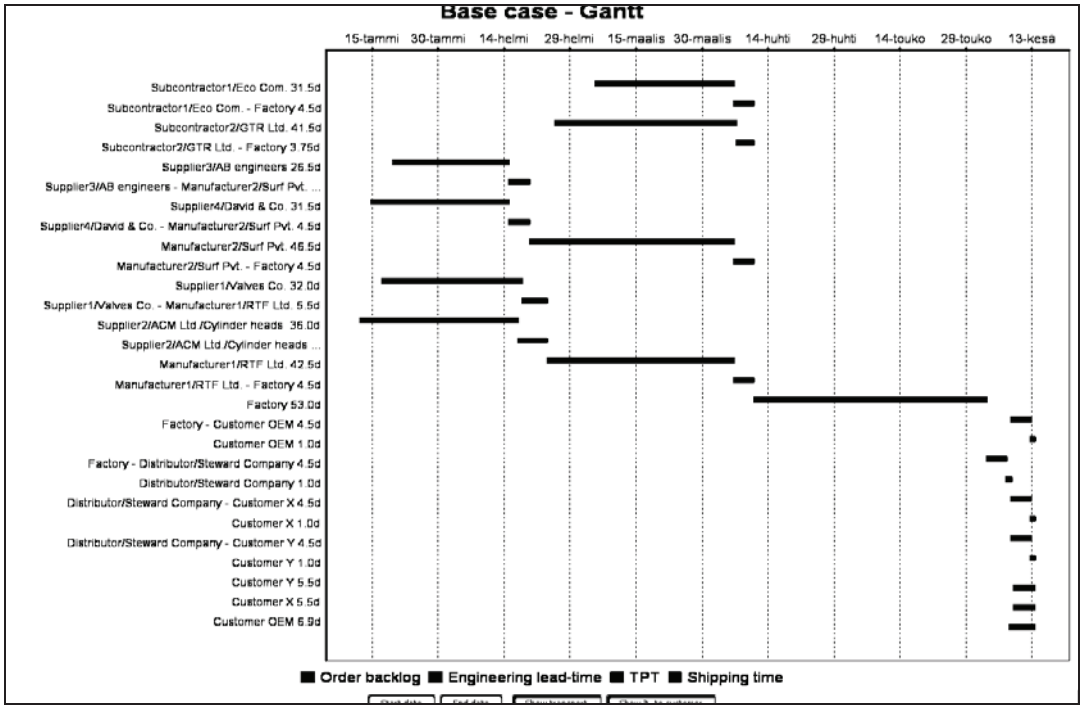

Figure 4: Gantt chart for the suppliers, manufacturers, subcontractors and distributor

Inventory value and level also can be seen in Figure 5. From Figure 5 it is observed that the inventory level and value of piston from Surf Pvt. is the highest among all components with valued €5,000,000.00 and the car engine in the Factory is the second highest inventory level and value of amount € 3,650,000.00. It is therefore essential to give particular attention on these two sections in order to minimize the inventory cost by changing order decoupling strategies like MTO, ATO etc.

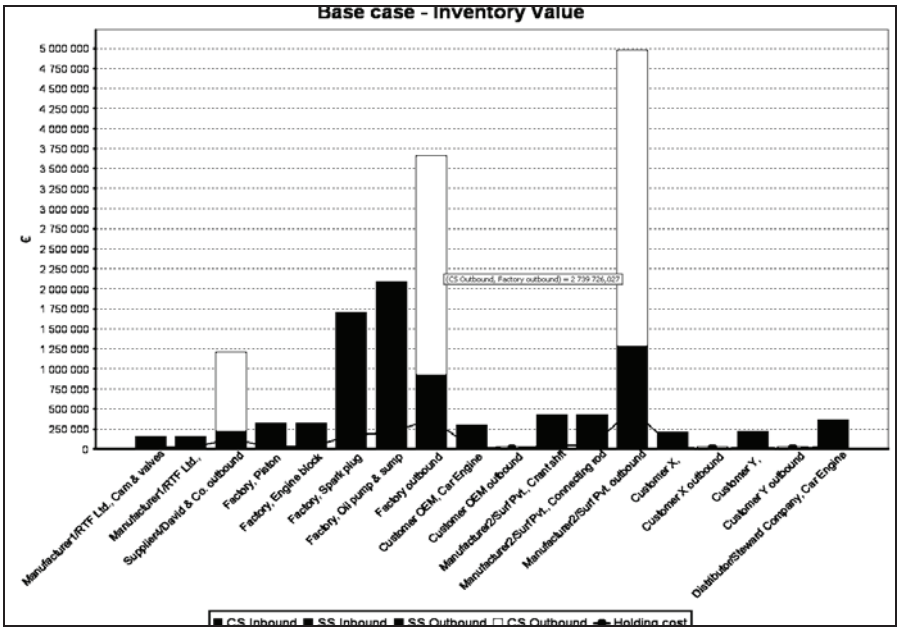

Figure 5: Inventory values of different components

Figure 6 shows the simulated result for capital tied per day. It is seen that supplier AB engineers for crank shaft has the highest value of capital tied per day while manufacturer Surf Pvt. for piston has the second highest and subcontractor GTR Ltd. for oil pump & sump has the lowest value.

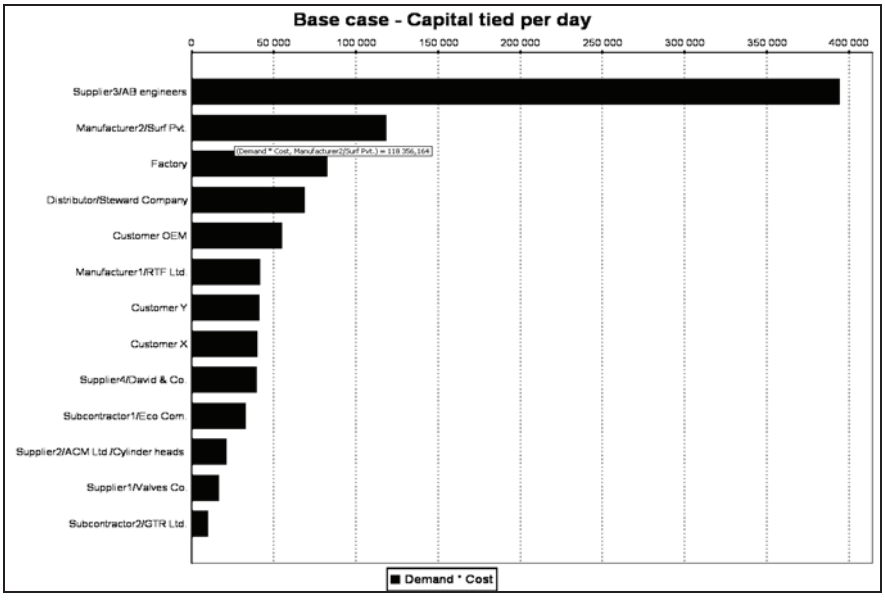

Figure 6: Capital tied per day of suppliers, manufacturers, subcontractors and distributor

In Figure 7, we can observe the value-added for suppliers, manufacturers, subcontractors and distributor. Cost and price for each participant within the supply chain network can also be seen here.

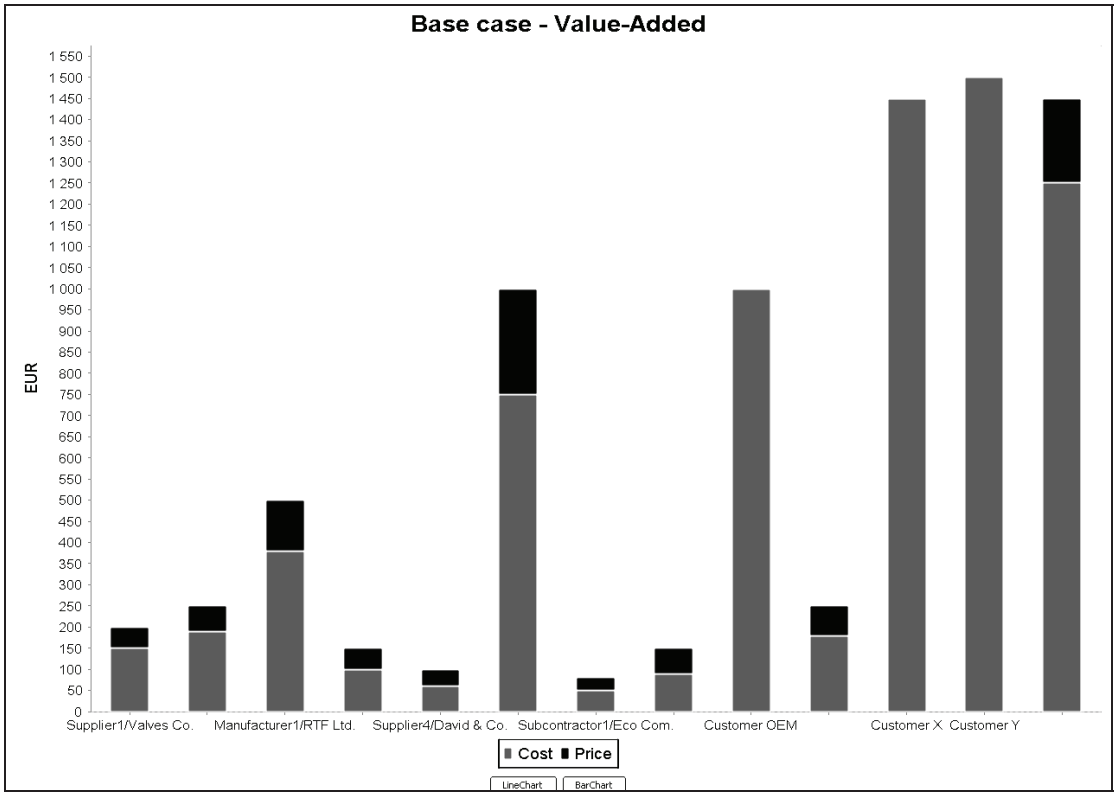

Figure 7: Value-added of each component with cost and price

Table 2 below highlights the input value of different node of the whole car engine assembly network. It shows the various related data of each node such as; product type, order decoupling point, cost, price, demand level, production through put time, shipping time and so on. This table summarizes all the information related with each node of the network. Table 3 outlines the output value of the nodes within the network. It is also highlighted the various output result of each node such as; supplier lead-time, lead-time to customers, average inventory both in units and in euro, safety inbound and outbound stock and so on.

Table2: Input values of different nodes in the supply chain network

Node table view...

Input | Output

	Supplier1/Valves Co.	Supplier2/ACM Ltd...	Manufactur...	Supplier3/...	Supplier4/D...	Factory	Subcontra...	Subcontrac...	Customer ...	Manufacture...	Customer X	Customer Y	Distributor...
ID	0	1	2	3	4	5	6	7	8	9	10	11	12
Label	Supplier1/Valves Co.	Supplier2/ACM Ltd./C...	Manufacturer1...	Supplier3/AB...	Supplier4/Davi...	Factory	Subcontract...	Subcontractor...	Customer OEM	Manufacturer2/...	Customer X	Customer Y	Distributor/St...
Product Type	Cam & valves		Engine block	Crant shft	Connectin...	Car...	Spark plug	Oil pump ...	Car Engine	Piston	Car Engine	Car En...	
Type	Supplier	Supplier	Manufact...	Supplier	Supplier	Ma...	Subcont...	Subcontr...	End cust...	Manufactu...	End cust...	End cu...	Sales co...
Order Decoupling Point	Assembly-to-Order	Assembly-to-Order	Assembly-...	Enginee...	Make-to-S...	Ma...	Make-to...	Make-to-...	Make-to-...	Make-to-St...	Make-to...	Make-t...	Assembl...
Price	200.0	250.0	500.0	150.0	100.0	1000.0	80.0	150.0	1000.0	250.0	1450.0	1500.0	1450.0
Cost	150.0	190.0	380.0	100.0	60.0	750.0	50.0	90.0	1000.0	180.0	1450.0	1500.0	1250.0
Demand	40000.0	40000.0	40000.0	1440000.0	240000.0	40000.0	240000.0	40000.0	20000.0	240000.0	10000.0	10000.0	20000.0
Demand st. deviation	312.5	312.5	312.5	312.5	312.5	312.5	312.5	312.5	200.0	312.5	400.0	450.0	425.0
Working Time	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0	52.0
Production Throughput time (...	20.0	25.0	25.0	15.0	20.0	30.0	20.0	25.0	1.0	25.0	1.0	1.0	1.0
St.deviation of OLT	2.0	5.0	7.0	5.0	4.0	10.0	5.0	5.0	0.0	15.0	0.0	0.0	0.0
Order backlog	10.0	10.0	15.0	10.0	10.0	20.0	10.0	15.0	0.0	20.0	0.0	0.0	0.0
Shipping time	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0
Engineering lead-time	1.0	0.0	0.5	0.5	0.5	1.0	0.5	0.5	0.0	0.5	0.0	0.0	0.0
Capacity	150.0	250.0	300.0	500.0	800.0	200.0	900.0	250.0	20000.0	825.0	10000.0	10000.0	100.0
Maximum order fulfillment time	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTD	80.0	85.0	75.0	75.0	80.0	80.0	75.0	80.0	99.99	70.0	99.99	99.99	99.99
Holding cost rate	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Table 3: Output values of different nodes in the supply chain network

Node table view...

Input | Output

	Supplier1...	Supplier2...	Manufacturer1...	Supplier3...	Supplier4...	Factory	Subcontractor1...	Subcontractor2...	Customer OEM	Manufacturer2...	Customer X	Customer Y	Distributor...
Supplier lead time	0.0	0.0	46.4	0.0	0.0	53.25	0.0	0.0	6.9	35.13	5.5	5.5	6.9
Internal lead-time	21.0	26.0	27.0	16.5	1.0	2.0	21.0	26.0	0.0	1.0	0.0	0.0	1.0
Lead time to customer	35.2	39.9	48.75	30.63	1.2	2.4	36.25	46.2	0.0	1.3	0.0	0.0	1.0
Service	80.0	85.0	75.0	75.0	80.0	80.0	75.0	80.0	99.99	70.0	99.99	99.99	99.99
Average inventory in units	0.0	0.0	840.96	0.0	12072.33	9582.57	0.0	0.0	323.27	24697.07	165.51	166.26	294.33
Average inventory in EUR	0.0	0.0	319565.81	0.0	1207233.11	8101998.99	0.0	0.0	323274.8	5840102.45	239995.0	249385.51	367914.71
CS Inbound	0.0	0.0	383.56	0.0	0.0	2736.99	0.0	0.0	191.78	2301.37	95.89	95.89	191.78
Safety inbound stock	0.0	0.0	73.84	0.0	0.0	185.3	0.0	0.0	102.06	171.04	51.85	52.08	102.55
Inbound inventory value	0.0	0.0	319565.81	0.0	0.0	4441716.59	0.0	0.0	293839.18	859280.41	214220.75	221958.11	367914.71
CS Outbound	0.0	0.0	0.0	0.0	9863.01	2739.73	0.0	0.0	27.4	14794.52	13.7	13.7	0.0
Safety outbound stock	0.0	0.0	0.0	0.0	2209.32	920.56	0.0	0.0	2.04	5128.77	4.08	4.59	0.0
Outbound inventory value	0.0	0.0	0.0	0.0	132559.04	690417.28	0.0	0.0	2038.36	923178.17	5911.23	6879.45	0.0
Inventory turn rate	Infinity	Infinity	47.56	Infinity	19.88	4.17	Infinity	Infinity	61.87	9.72	60.42	60.15	67.95
Capacity utilisation	73.06	43.84	36.53	789.04	82.19	54.79	73.06	43.84	0.27	79.7	0.27	0.27	54.79
Throughput Dollar Days	273.97	263.01	526.03	1666.67	1315.07	913.24	986.3	263.01	0.0	1841.1	0.0	0.0	10958.9
Inventory Dollar Days	NaN	NaN	1.52E7	NaN	2.4E7	3.381972889E7	NaN	NaN	2.0E7	5.675267103E7	1.45E7	1.5E7	2.5E7

Various parts or components are shown in Figure 8 where it can be seen that highest number of goods are transported from supplier 'AB engineers' to manufacturer 'Surf Pvt.' for crank shaft numbered almost 18000. The number of parts transported from supplier David & Co. to manufacturer Surf Pvt.; manufacturer Surf Pvt. to Factory and from subcontractor Eco Com. to Factory for connecting rod, piston and spark plug respectively are of the same amount numbered 3000. All other parts are transported less than 1000 units.

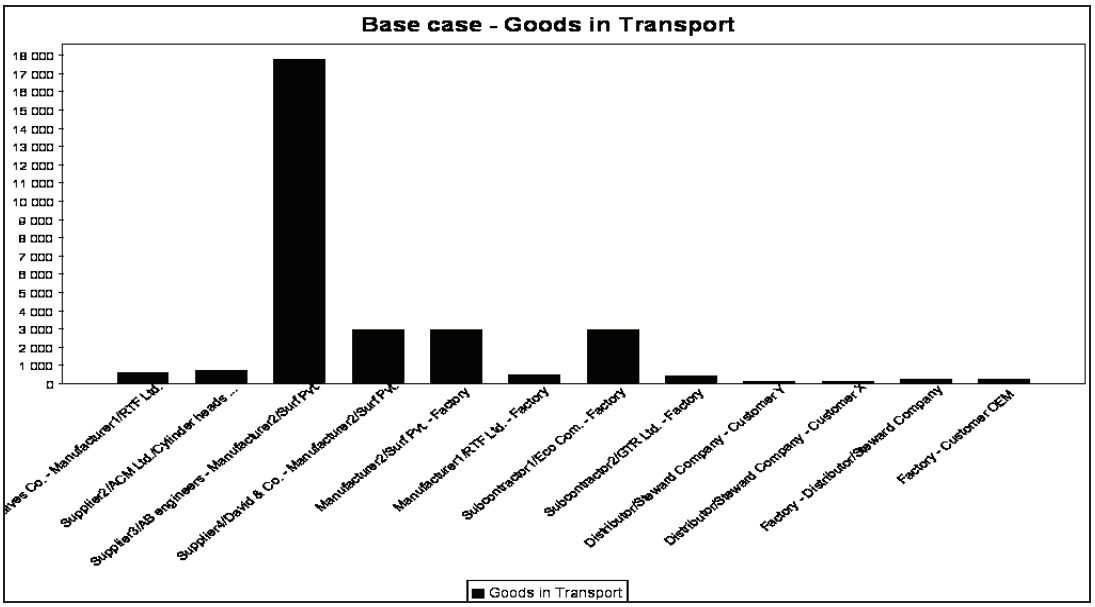

Figure 8: Goods in transport within the supply chain network

Table 4 below outlines the financial matters related with inventory holding cost, inventory turns, cycle time for production, lead-time to customers and safety stock holding cost. It is observed that there is no costs for safety stock as for this engine assembly no need to maintain inventory for safety level. The average lead-time from factory to customer is 5.97 days; total cycle time to assemble the engine is 153 days; inventory turns 0.83 turns /year and average inventory holding cost is €1664947.04.

Table 4: Financial data for different performance measures

Financials

	Base case
Safety Stock Holding Cost [EUR / year]	0.0
Lead time to customer [days]	5.97
Cycle time [days]	153.0
Inventory turns [turns/year]	0.83
Inventory Holding Cost [EUR]	1664947.04

Close

MANAGERIAL IMPLICATIONS

Increasing levels of outsourcing, costs, competitive pressures, globalization, importance of e-commerce and the complexity of supply chain forcing manufacturing firms to distribute their supply networks from local or regional to international level (Stevenson, 2002). This shifted strategy influences for the need to improve operations for ever growing globalization and increased customer expectations for customized products or services. Manufacturers continue to internationalize their production, supplier and customer bases to exploit opportunities for revenue growth and cost reduction. Customers and corporate buyers demand for more choices, accurate and faster deliver and greater value of their products. To meet these requirements, a coordinated supply chain can be designed in order to fulfil the strategic and operational objectives of the business such as, line scheduling, material and inventory allocation, transportation planning etc.

Globalized networks of products and services are highly complex and sometimes unpredictable for any change. To manage this growing complexities and gaining competitive advantage, companies leading towards value networks by covering critical issues such as off-shoring, outsourcing and managing risks in the value chain. The risks associated with the value chain can be covered through strategic management of supply and distribution network. This network approach provides continuous monitoring, reporting, troubleshooting and quick response capabilities which are necessary to manage a complex supply chain network infrastructure. Coordinated supply and demand chain enables the fast pinpointing of the root of problems and risk assessment to prioritize the most critical problems along the product development network. This ensures the agility in supply chain network in a globally distributed environment which significantly decreases the total cost structure by maximizing the service levels, resource allocation and planning capabilities for companies.

To meet the goals of producing right product, at right place and right time is not an easy proposition when managing a globally distributed supply chain which can be comprised of multiple geographically dispersed sites and/or partners. Complexities arise with the volatile business environment of increasingly unpredictable demand, shortening product life cycles and inability to quickly and effectively respond to change. Companies that have the ability to quickly sense and respond to change can drive breakthroughs in operating performance and leveraging their supply chains to drive top-line growth. In today's market, proper management of distributed supply chain greatly influenced by companies supply chain responsiveness and higher customer service. Due to this reality, supply chains can no longer be viewed as just part of the corporate infrastructure but rather part of the corporate strategy. Managers rightly need to evangelize supply chain excellence as a strategic priority to gaining competitive advantage and market gain.

There are several issues that should be considered when selecting an appropriate strategy of operating supply chain management for companies. Today's collaborative production processes depend mostly on accurate and timely information exchange among the whole product development chain. This information exchange needs to be updated on a regular basis between the suppliers, distributors and manufacturers. The ASDN software as described in this paper could be good tool for companies' managers to handle with their information exchange among product development parties. This tool allows the issue of sharing information and responds to changes in the marketplace. It enables managers to visualize the different phases of developmental process from product concept generation to production ramp up. Different performance measures such as; level of inventory, transportation media

and cost, lot size, shipping time, ODP, service level etc could be managed efficiently for quality products or services.

CONCLUSION

In product design and development, manufacturers rely mostly on mega-suppliers distributed all over the world. This globalization of supply network has forced manufacturing firms to look for effective ways to coordinate the flow of materials into and out of the firm. These mega-suppliers are the real developers of technology and systems for the assemblers (Youngdahl and Loomba, 2000). This globalization and increased performance-based competition, combined with rapidly changing technology and economic conditions, all contribute to business uncertainty. To overcome this uncertainty, firms require greater flexibility on the part of individual supply chains, which in turn demands more flexibility in supply chain relationships. Customers are demanding products consistently delivered faster, exactly on time and with higher quality. To meet up each of the customers requirements, firms need to closer coordination with suppliers and distributors (Mentzer et al., 2001).

The manufacturers have to control not only outbound logistics networks but in most cases after sales service too. It is therefore crucial to configure and coordinate this complex supply chain networks for steady growth of industries with higher revenue earnings. The objective of this paper is to demonstrate the necessities of managing distributed supply network and to show how technology could be applied for optimizing the decision making process. From this research point of view, a simple supply network is created for a car engine assembly factory where different parts were outsourced through different suppliers within Europe. The simulated results are presented in order to achieve the optimized network goals such as; reduction of lead-time and cost or profit maximization. In a distributed supply chain environment, this network solution and methodology could be very much helpful for simulating the required performance measures and services.

Due to the growing off shoring of manufacturing processes, companies are facing a number of challenges from the complexity of supply chains. To manage demand variability and supply disruptions, companies are forcing to adopt software based solutions approach to prevent opportunity losses and higher cash conversion cycles. In order to having an agile supply network which connects demand, supply and product in the top priority, companies need a complete, integrated solution that empowers information-driven supply chains. With ASDN software as discussed in this paper, companies can predict market requirements, innovate in response to volatile market conditions and align operations across global networks. This tool provides industry specific solutions based on best-in-class applications that span product development, demand management, sales and operations planning, transportation management and supply management.

The ASDN software offers manufacturing firms proven best-of-breed capabilities to streamline their global supply chain operations. To achieve competitive advantage, firms could use this technology in order to support from planning and forecasting to sourcing and production through warehousing and transportation management. This method provide the flexibility and visibility which is needed to proactively plan, source, schedule, produce, store, transport and trace supply chain activities, in industries with distribution intensive supply networks. The software allows companies to leverage flexible what-if analysis and dynamic feedback to best synchronize activities throughout the supply chains. This results company with increased revenue, reduced cycle times, improved forecast accuracy, optimize inventory,

leverage production efficiencies, reap transportation savings and improve overall customer satisfaction.

Distributed supply chain can be extended not only the existing product but also for the new product development process. The approach of collaborative product development supports firms to integrate their supply chain efficiently. The design of distributed product development processes is a core element of supply chain management. The development of new complex products normally requires a tight collaboration between producers and their suppliers. It is required to integrate supply network as early as possible to the development process in order to achieve know-how of the suppliers efficiently. Web based technologies and software's can open new possibilities for the design interaction mechanisms and can therefore support the suppliers' integration with the producers. To support the cooperation between suppliers and producers, internet based design of distributed product development processes offer shared access to a common data and information base, which provides suitable tools for communication and coordination.

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SUPPLY CHAIN ANALYSIS OF THE DEFENCE SECTOR

Dr. Štefan Bojnec, University of Primorska, Slovenia
stefan.bojnec@fm-kp.si
Dr. Ajda Fošner, University of Primorska, Slovenia
ajda.fosner@fm-kp.si

ABSTRACT

The unique in-depth survey evidence on the defence industry enterprises and the analysis of their fore-ward supply market chain linkages are rare in literature. The statistical input-output matrix and the in-depth unique survey sample of the 64 Slovenian defence industry and technology base enterprises is analyzed using input-output modelling approach. The Slovenian enterprises by production, supply in return and subcontracting, middlemen and traders activities in the defence marketing chains by the three analyzed segmented geographic markets are mostly oriented on the domestic Slovenian market. Rare enterprises are specialized exclusively for the activities on the external European Union and the rest of the world markets.

Keywords: supply chain management, defence sector, input-output analysis, Slovenia

INTRODUCTION

Previous analyses have indicated the presence of economic relations between the defence technological and industrial base activities with the rest of the economy (e.g. Kolar 2007). These inter-sector, multiplicative economic effects are potential factor for economic growth (e.g. Davis 2008). The developed technological and industrial base activities provide competitive market opportunities for medium-high and high-technological intensive industries, which can create supply-side synergies and demand multiplicative effects on other economic activities by providing basis for their international competitiveness (e.g. Gandolfi 2007). Moreover, state defence budgets that are allocated toward development of the defence technological and industrial base activities as well as for defence supply chain management of industrial and service activities generate demands for direct and indirect supply chains from different economic activities and thus through these causalities cause synergies that generates economic growth. From macro-economic and inter-sector point of views (e.g. Chenery and Srinivasan 1989), the impacts of the defence sector is through aggregate direct and indirect demands for products of different economic activities for the defence sector and through aggregate supply of different kind of the defence industry enterprises. Both effects can generate positive effects for economic growth.

The direct and indirect linkages of the defence technological and industrial base activities in the economy might have important role on overall economic performances, production, supply and supply in return management, middlemen, and trader activities, and thus for competitiveness of the economy. These defence sector activities might provide a special opportunity for a greater role of small- and medium-sized enterprises, which in several developed countries are the most dynamic element in a job creation and the most recently, they are one of the key organizational

structures in research and development activities, inventions and innovations and their disseminations and implementations into different industrial and service activities. There is, however, very limited research on the role and importance of the defence technological and industrial base activities, particularly in production, supply and supply in return management, middlemen and trader activities by using matrix theory (e.g. Lam et al. 2008; Iwankowicz 2008) and input-output methodological approach (e.g. ten Raa 2006).

Therefore, the first significant contribution of this paper is that we analyse direct linkages of the defence industrial and technological base sector activities with the rest of the economy. More specifically, we analyse the country's defence industry flows in the defence industrial and technological base sector activities. We underline that not only direct producers and direct suppliers links are important, but also different other links with suppliers in return, midleman and traders activities. The defence technological and industrial base activities are not linked only to the pure defence sector, but are also linked with the rest of the economy and with internatinal trade flows. This implies policies that are less purely defence, but market driven in an open and global international trade environment with goods, services and their outsourcings (e.g. Heather 2002, Allen 2005). The second significant contribution is the unique defence industry data management. The commercialization and marketization of the defence technological and industrial base sector activities might be still limited as several those activities are of a secure nature. This migh be one of the reasons that not many researches so far has been conducted and not many evidence is available to be analyzed and compared. That is the main reason that our research rely on the own unique in-depth data set, which has been obtained by the conducted surveys in the Slovenian enterprises that are engaged in different business activities with the defence technological and industrial base activities.

The rest of the paper is structured as follows. In the next section we explain the methodology on application of linear algebra in the input-output industry data management focusing on the defence industry sector to provide an analytical data management tool with managerial implications. We also present the data used on the statistical input-output table and on the unique survey evidence on the linkages of the defence technological and industrial base activities with the rest of the economy and with the international trade flows (e.g. Kenen and Lubitz 1971). The next section describes the empirical results on the direct fore-ward linkage coefficients for the direct supply-side cross-sectoral linkages and the unique in-depth empirical results from the surveys in the Slovenian defence sector industry enterprises. After this, we provide managerial and policy implications for data management systems in the defence sector and methodological issues for future research, whereas final section derives main conclusions.

METHODOLOGY AND DATA USED

We present the application of linear algebra in input-output modelling in the industry cross-sector data management focusing on the defence industry sector. The linear algebra mathematical methods and input-output modelling provide a base for the data management in the cross-sector back-ward and fore-ward industry linkages. To analyse the linkages of the defence technological and industrial base activities with the rest of the economy and with international trade flows, we find useful to apply matrix theory, which is a base for an input-output modeling

in the data management. In our case the focus is on the defence sector industry. A compilation of the input-ouput matrix for the defence technological and industrial base activities would be appropriate, but due to data availability problems, our applied empirical research is limited to the direct fore-ward supply-side cross-sector linkages of the defence technological and industrial base activities. We employ statistical input-output matrix of the economy and our unique in-depth survey data results for Slovenia as the member of the enlarged European Union (EU-27). Further, we employ methods of economic analysis, which are based on the analysis of cross-sectoral flows between the defence techological and industrial base sector with the different parts of the economy and with the international trade flows. In addition, we focus on the three different market orientations on domestic vis-à-vis two geographically segmented foreign markets. The latter are distinguished into the enlarged EU and other the reset of the world international markets. The input-ouput modelling is an appropriate methodological tool to measure economic relations between different economic activities. This methodological approach with the use of the input-output matrix of inter-sectoral and inter-country economic flows can show the structure of direct fore-ward supply-side linkages of the defence sector activities with the rest of the economy and with the international trade flows. Our special focus is on the direct defence industry production fore-ward supply links, on supply in return and subcontracting links, on middelmen and traders activities within the national economy and in trade with the enlarged EU and the rest of the world markets.

In the empirical analysis we present the direct cross-sector linkages between the economy sectors focusing on the explanation of the part of the input-output table, which is related to the suppply-side of the defence industry sector. The source of this data is the input-output matrix of the Statistical Office of the Republic of Slovenia (SORS 2008). We focus on the direct linkages, which relate to the fore-ward supply-side linkages. The relation between production and consumption in the economy can be analysed by the use of the statistical input-output matrix. The symmetric input-output matrix is based on tables of supply and consumption in the economy. The input-output matrix presents process of domestic production and transactions of products and services at the level of products or adjusted at the branch level (SORS 2008). At the aggregate economy level, input-output table is a matrix with rows and columns at the level of product/branch with the sum by rows or columns gives the final value of production or gross domestic product (GDP). The row *i* in the input-output matrix shows how the output/product of the sector *i* is used in the intermediary consumption of the all sectors in the economy and in final consumption. We investigate fore-ward sells or delivery structures to the other sectors in the economy and the expenditure distribution of value-added for final household consumption, gross investments, government consumption, and net export as the difference between exports and imports in the row of the input-output table. The input-output model assumes linear production function with fixed coefficient at least on short-term. The coefficient of sell structure for intermediate consumption si_j indicates the structure of sells of the sector *j* for the intermediate consumption of the other sectors *i* in the economy:

$$si_j = \frac{X_{ij}}{X_j}$$

where X_j is total production or sale of the sector *j* and X_{ij} is the sell of sector *j* for the intermediary consumption of the sector *i*. Similar as the coefficient si_j, we can define the coefficient of sell structure for final use sf_j that indicates the structure of sells of the sector *j* for the final consumption in the economy and for exports:

$$sf_j = \frac{F_j}{X_j},$$

where F_j is the final consumption in the economy and exports. This direct input-output modelling approach is used for investigation of causalities of the sector public administration and defence services; compulsory social security services, which is classified as one of the sectors in the Slovenian statistical input-output table. We use 30 sectors symmetric input-output tables for Slovenia for 2005 valued at basic prices, which are compiled every five years (SORS 2008). The input-output table total economy flows are distinguished separately by domestic flows and international flows. The classification used for industries is Statistical Classification of Economic Activities in the European Community (NACE Revision 1 or Slovenian version of the Standard Classification of Activities) and for products is the Classification of Products by Activity.

Our special focus are the Slovenian defence industry enterprises and their role in the supply chain management of the defence technological and industrial base activities on the basis of the unique survey data. We analyse the structures of the defence sector production supply, supply in return and subcontracting activities, middlemen and trader activities of the defence technological and industrial base activities. The defence technological and industrial base activities are analysed for their direct linkages by the frequency of the distribution of the defence sector enterprises. The analysed defence sector activities are separated between domestic and international or external flows. The in-depth survey data evidence, which is used in this paper, is obtained by personal interviews in the Slovenian defence industry enterprises with a pre-prepared written questionnaire. The surveys were conducted in the Slovenian enterprises, which are on the list of the Slovenian Ministry of Defence that they are engaged in the defence industry and technological base activities. From the list of around 100 enterprises, we have successfully conducted the surveys in the 64 Slovenian enterprises, which are engaged in the business activities with the defence technological and industrial base activities in Slovenia. The surveys were conducted in November and December 2007. The questions in the written questionnaire were divided into six thematic subjects. In this paper, we focus on the data evidence that is obtained on the three of them: the main evidence on the enterprise profile, on the importance of the defence technological and industrial base activities in the enterprises, and the in-depth evidence on the defence production-supply chain activities, supply in return and subcontracting activities, and middlemen and trader activities.

According to the size of the enterprises by the number of employees and by the revenues, in the sample are included: 48.4 per cent small enterprises, 26.6 per cent medium-sized enterprises, and 25.0 per cent large enterprises. This implies that most of the enterprises in the Slovenian defence technological and industrial base activities are the small- and medium-sized enterprises.

By the NACE production activity classification, most of the enterprises in the sample operate in the service activities (70.9 per cent), then 15.0 per cent in production activities, and 14.1 per cent in manufacturing activities. Most of the Slovenian enterprises in the defence technological and industrial base activities are engaged in advices, maintenance, information and information technologies, logistics, education, research, providing infrastructure and other services in the Slovenian army.

EMPIRICAL RESULTS

The input-output analysis, particularly on measuring direct and indirect multiplicative effects using linear algebra mathematical approach can provide wider application opportunities of these methodological approaches in the industry data management. In the Slovenian statistical input-output matrix, the defence sector belongs to the public administration and defence services; compulsory social security services. Table 1 presents results obtained from the symmetric input-output table for domestic output at basic prices for Slovenia in 2005, which is divided into domestic and export sub-matrices. It is clearly confirmed that in the domestic matrix as well as for total sells, there is the final consumption expenditure by government, which are the most important. The export flows are less concentrated, but still there are three market outlets, which are the most important: intermediary consumption in transport, storage and communication services; final consumption expenditure by households; and intermediary consumption within public administration and defence services; compulsory social security services.

Table 1. Coefficients of Sell Structure of the Public Administration and Defence Services; Compulsory Social Security Services

	Total	Domestic	Export
Products of agriculture, hunting and forestry	0.001	0.001	0.012
Fish	0.000	0.000	0.000
Coal and lignite; peat; crude petroleum and natural gas; uranium and thorium	0.000	0.000	0.000
Metal ores and other mining and quarrying products	0.000	0.000	0.000
Food products, beverages and tobacco	0.001	0.001	0.007
Textiles and textile products	0.000	0.000	0.004
Leather and leather products	0.000	0.000	0.000
Wood and wood products	0.000	0.000	0.000
Pulp, paper and paper products; recorded media; printing services	0.000	0.000	0.003
Coke, refined petroleum products and nuclear fuel	0.001	0.001	0.020
Chemicals, chemical products and man-made fibres	0.000	0.000	0.002
Rubber and plastic products	0.000	0.000	0.000
Other non metallic mineral products	0.000	0.000	0.006
Basic metals and fabricated metal products	0.002	0.002	0.016
Machinery and equipment n.e.c.	0.000	0.000	0.001
Electrical and optical equipment	0.001	0.001	0.012
Transport equipment	0.000	0.000	0.002
Other manufactured goods n.e.c.	0.002	0.001	0.019
Electrical energy, gas, steam and hot water	0.002	0.001	0.017
Construction work	0.003	0.003	0.031
Wholesale and retail trade services; repair services of motor vehicles, motorcycles and personal and household goods	0.006	0.006	0.066
Hotel and restaurant services	0.001	0.001	0.010
Transport, storage and communication services	0.021	0.019	0.256
Financial intermediation services	0.002	0.002	0.027
Real estate, renting and business services	0.005	0.005	0.065
Public administration and defence services; compulsory social security services	0.011	0.010	0.126
Education services	0.001	0.001	0.007
Health and social work services	0.000	0.000	0.003
Other community, social and personal services	0.003	0.003	0.036
Private households with employed persons	0.000	0.000	0.000
Total intermediate consumption	0.066	0.059	0.747
Final consumption expenditure by households	0.022	0.020	0.253
Final consumption expenditure by NPISH	0.001	0.001	0.000
Final consumption expenditure by government	0.905	0.913	0.000
Gross fixed capital formation and valuables	0.000	0.000	0.000
Changes in inventories	0.000	0.000	0.000
Exports f.o.b.	0.006	0.006	0.000
Total final use	0.934	0.941	0.253
Total use	1.000	1.000	1.000
Total use, current prices, mio sit	558.001	552.976	5.025
Total use (in percent)	100.0	99.1	0.9

Source: Own calculations from data obtained from SORS (2008).

Because our special focus is on the data management for the defence sector, we use our unique survey evidence on the defence industrial and technological base activities in Slovenia. The advantage of our data set is in its uniquines at the micro enterprise level. This unique evidence is available only for Slovenia. As it is presented in Table 1, data at the national level for the defence sector in the national account statistics and national input-oputput matrix tables are presented at the aggregate level, which do not provide an opportunity for the in-depth analysis within a certain sector. This was the reason to conduct the surveys in enterprises, which are

engaged in the defence industrial and technological base activities. On the basis of the created dataset, we analyse and compare the defence industry enterprises in supply chain management of the defence industrial and technological base activities.

Therefore, due to the data limitations, we limit our empirical analysis on the direct defence industry enterprise linkages. We first present the frequency distribution of the defence industry enterprises in Slovenia by the structure of primary production in the enterprises for the needs of the defence industrial and technological base activities by the three different geographically segmented markets: the national Slovenian market, the markets of the other enlarged EU-26, and the other markets in the rest of the world (Table 2).

Table 2. Distribution of the Enterprises with Their Market Outlets for Primary Production for the Needs of the Defence Industrial and Technological Base Activities (in per cent)

Frequency distribution of enterprises (%)	National Slovenian market	EU-26	The rest of the world markets
0%	31.7	65.1	66.7
1-49%	28.6	22.2	17.4
50-99%	17.5	12.7	15.9
100%	22.2	0.0	0.0
Total (%)	100.0	100.0	100.0

Source: Own survey results.

Considering the national Slovenian market, for several defence industry enterprises in our sample, the national market is not important for primary production supply chain management, which is related to the defence industrial and technological base activities. On the other hand, the significant proportion of the enterprises (22.2 per cent) is selling all its primary production of the defence industrial and technological base activities on the national Slovenian market. The other defence industry enterprises are marketing the different degree of primary production of the defence industrial and technological base activities on the national Slovenian market. The results indicate that around 40 per cent of the defence industry enterprises in our sample sell at least 50 per cent of their primary production of the defence industrial and technological base activities on the national Slovenian market, whereas the remaining around 60 per cent of the enterprises in the sample sell less than 50 per cent of their primary production for the needs of the defence industrial and technological base activities on the domestic Slovenian market. On average, a bit more than 40 per cent of primary production for the needs of the defence industrial and technological base activities is supplied on the domestic Slovenian market. However, this varies by the enterprises substantially as the standard deviation is 41.9 per cent.

When considering the enlarged EU market, the domestic Slovenian market is prevailing as around two-third of the enterprises in the sample are engaged only in the defence business activities on the domestic Slovenian market. The relative frequency of the distribution of the enterprises for the supply of primary production for the needs of the defence industrial and technological base activities with the EU-26 markets clearly indicate that 65.1 per cent of the enterprises are not engaged in these EU business activities. Yet, the relative frequency of the

distribution of the enterprises in the sample that are not engaged in the supply of primary production for the needs of the defence industrial and technological base activities with the other markets in the rest of the world is even a bit higher (66.7 per cent).

Moreover, we present the relative frequency of the distribution of the Slovenian defence industry enterprises in the supply in return or sub-contracting activities for the needs of the defence industrial and technological base activities by the three different geographically segmented markets: the national Slovenian market, the enlarged EU-26 markets, and the other markets in the rest of the world (Table 3). The share of the enterprises that are not engaged in the supply in return or subcontracting activities on the domestic Slovenian market is relatively high (55.6 per cent), but it is even much higher for similar activities towards the EU-26 markets (76.2 per cent) and the other markets in the rest of the world (82.5 per cent). The relatively high share of the Slovenian defence sector enterprises (25.4 per cent) is also identified for the supply in return or subcontracting activities that are exclusively specialized for the domestic Slovenian markets, but none to the EU-26 markets and only one to the markets in the rest of the world. These results indicate that the Slovenian defence sector enterprises are not very frequently engaged in the supply in return or subcontracting activities. There are only few enterprises in Slovenia that specialize in the defence supply in return or subcontracting activities on the Slovenian market and to lower degree for similar activities in the EU-26 markets, and much a rare for the other markets in the rest of the world.

Table 3. Distribution of Enterprises with Market Outlets for Supply in Return or Subcontracting Activities for the Needs of Defence Industrial and Technological Base Activities (in percent)

Frequency distribution of enterprises (%)	National Slovenian market	EU-26	The rest of the world markets
0%	55.6	76.2	82.5
1-49%	6.3	9.5	15.9
50-99%	12.7	14.3	0.0
100%	25.4	0.0	1.6
Total (%)	100.0	100.0	100.0

Source: Own survey results.

We also investigate the engagement and distribution of the Slovenian defence sector enterprises in the defence chains as the middlemen (traders) on the national Slovenian market, on the enlarged EU-26 markets, and on the rest of the world markets (Table 4). The distribution of the enterprises on the Slovenian market is more symmetric than on the EU-26 markets and on the rest of the world markets. A large share of enterprises is not engaged into the defence chains as middlemen (traders): 51.6 per cent are not engaged on the domestic Slovenian market, 79.7 per cent are not engaged on the enlarged EU-26 markets, and 84.4 per cent are not engaged on the markets in the rest of the world. On the other hand, there is a relatively high share of enterprises (31.3 per cent), which are fully specialized and engaged in the defence chains as the middlemen (traders) on the domestic Slovenian market, but less so for the enlarged EU-26 markets and none of them is fully engaged on the rest of the world markets. The results indicate that more than 40 per cent of the enterprises are more than 50 per cent engaged in the defence chains as the

middlemen (traders) on the domestic Slovenian market. On average, the enterprises in the sample are 38 per cent engaged in the defence chains as the middlemen (traders) on the domestic Slovenian market, with a large variability by the enterprises as confirmed by the standard deviation of more than 45 percentage points. This implies rather a bi-polar distribution of the Slovenian defence industry enterprises in these activities. Moreover, much more asymmetric is found the distribution of the enterprises with a higher concentration at lower average value (9.6 per cent and relatively lower variability as the standard deviation is a bit more than 25 percentage points) for the engagement in the defence chains as the middlemen (traders) on the enlarged EU-26 markets. The average value for the engagement of the enterprises in the markets in the rest of the world is a bit lower (7.97 per cent and lower is also variability as suggested by the standard deviation of a bit more than 22 percentage points). This implies that the Slovenian defence industry enterprises in these business activities are more similar regarding the engagement in the defence chains as the middlemen (traders) in the enlarged EU-26 markets and in the other markets in the rest of the world.

Table 4. Distribution of Enterprises with Market Outlets for Middlemen (Trade) Activities for the Defence Chains (in per cent)

Frequency distribution of enterprises (%)	National Slovenian market	EU-26	The rest of the world markets
0%	51.6	79.7	84.4
1-49%	7.7	10.9	6.2
50-99%	9.4	6.3	9.4
100%	31.3	3.1	0.0
Total (%)	100.0	100.0	100.0

Source: Own survey results.

We further investigate the Slovenian enterprise middlemen (traders) activities in the defence marketing chains regarding the purchasing activities abroad and the participation of the enterprises in the supply in return. In the both cases, we investigate the EU-26 markets and the markets in the rest of the world, respectively. As can be clearly seen from Table 5, the large share of the Slovenian defence sector enterprises in the sample is not engaged in the supply in return for the EU-26 markets and in the supply in return for the other markets in the rest of the world. The relatively high share of the enterprises in the sample is also not engaged in the purchasing activities from abroad: 49.2 per cent from the EU-26 markets and 66.7 per cent from the other markets in the rest of the world. These results clearly confirmed that a majority of the Slovenian enterprises that are engaged in the defence industrial and technological base middlemen (traders) activities are not oriented on international markets. However, 15.9 per cent of the enterprises specialized exclusively (hundred per cent) for the purchases in the EU-26 markets. On the average the enterprise in the sample on the EU-26 markets conducted a bit more than 33 per cent of all purchases. Furthermore, there is only one, a single enterprise, which specialized exclusively for purchases on the other markets in the rest of the world. On the average the enterprise in the sample in these markets conducted a bit more than 17 per cent of all purchases. Finally, the two enterprises are specialized exclusively in the supply in return for the EU-26 markets. On average the enterprise conducted around 11 per cent of the supply in return

on the EU-26 markets and around 4 percent of the supply in return on the other markets in the rest of the world. In the latter case, there is also the single enterprise that specialized exclusively for the supply in return for the other markets in the rest of the world. These results suggest that the enterprises in the defence middlemen (traders) activities are adjusting towards business opportunities in these markets, which are still more seen on the domestic Slovenian rather than in the international markets. This is a challenging issue for the Slovenian enterprises upon the Slovenian membership in the enlarged EU and in the North Atlantic Treaty Organization (NATO).

Table 5. Distribution of Enterprises with Market Outlets for Middlemen (Trade) Activities for the Defence Chains (in per cent)

Enterprise frequency (%)	Purchasing from abroad		Participation in supply in return for	
	EU-26	The rest of the world markets	EU-26	The rest of the world markets
0%	49.2	66.7	77.8	85.7
1-49%	15.9	14.2	11.0	12.7
50-99%	19.0	17.5	8.0	0.0
100%	15.9	1.6	3.2	1.6
Total (%)	100.0	100.0	100.0	100.0

Source: Own survey results.

MANAGERIAL AND POLICY IMPLICATIONS

During the last two decades since the fall of the Berlin's wall in Europe, the role and importance of the defence technological and industrial base activities has changed. The greater focus has been directed towards the defence technological and industrial base activities with a greater reliance on quality, invention, and innovation. A key question in managerial economics is economic efficiency (e.g. Heather, 2002; Allen, 2005). The small- and medium-sized business sector enterprises have been a constituent part in these processes of a greater openness, commercialization, and marketization of the defence technological and industrial base activities. However, in a spite of the increasing participation of the small- and medium-sized enterprises in the defence technological and industrial base production supply chain management, supply and supply in return chain management, and middlemen (traders) activities, these markets are still an issue of a special concern. Nevertheless, we have found the increasing role of the economic efficiency criteria in their marketing activities.

We have analyzed supply chain management in the defence technological and industrial base activities using the logic of linear algebra in the input-output analysis in the ways of production and types of supply and supply in return chain management, middlemen (traders) activities, and their impacts on the other economic activities. The crucial role is on services, middle-high, and high-technological products that have important positive synergies and multiplicative effects for the rest of the economy and for international trade. Among them, there is a strong link of the defence technological and industrial base activities with those sectors and enterprises that are a constituent part of the defence supply chain management in the fields of supply of material and services, particular in middlemen and trade activities, and supply in return for the defence sector.

On one hand, these are consumer goods and services that through aggregate demand are causing economic growth. On the other hand, the defence technological and industrial base activities are an important factor for strengthening of supply-side management, which is a crucial ground for an increase in competitiveness on supply-side and for economic growth through sales on domestic and international markets.

The empirical survey analyses of the defence industrial and technological base activity structures and marketing flows have confirmed the important role of the purchase back-ward demand-side activities and in the delivery fore-ward supply-side activities in the defence chain management of the defence technological and industrial base activities. The Slovenian defence technological and industrial base enterprises are strongly linked with the domestic Slovenian markets in primary production, supply in return and subcontracting activities, and in the defence chains as middleman and trader activities. The distribution of the enterprises in these activities is rather bi-polar. On one hand, several of these enterprises are not linked with the other similar domestic enterprises, but on the other hand, there are also several enterprises that are wholly (hundred percent) linked with the other similar domestic enterprises or with the domestic market. The remaining smaller number of enterprises is by a different degree linked with the domestic Slovenian markets. The share of the enterprises that are not engaged in the business activities with the enlarged EU-26 markets or with the other markets in the rest of the world is much higher. This implies that the Slovenian enterprises in the defence industrial and technological base activities are much more oriented on the domestic Slovenian markets than into the international trade and international competition. Their enterprise activities in primary production, supply in return or subcontracting activities, in middleman and trader activities are rather strongly associated between themselves on the domestic Slovenian market, which has been shown by rather a similar distribution of enterprises in these different activities on the three different geographically segmented market outlets (domestic Slovenian, enlarged EU-26, and the rest of the world markets).

The empirical analyses of production, supply in return, and subcontracting activities, middleman and trader activities by the three different geographically segmented market outlets have given results that are of broader policy relevance. The defence technological and industrial base activities in Slovenia are based on the small- and medium-sized enterprises, which has been clearly confirmed by the unique survey evidence. As there is no similar study for any other country, the direct comparison is not possible. This can be an issue for future research to compare possible similarity of Slovenia as a small open economy, which is the member of the enlarged EU and NATO, with the other countries in Europe and in the rest of the world.

CONCLUSION

The knowledge of linear algebra and input-output modelling is found as an important analytical tool in the industry data management for investigation of the back-ward and the fore-ward linkages between the economy sectors and with the international trade flows. The survey analyses for the Slovenian defence industry enterprises shows that the Slovenian defence technological and industrial base enterprises are strongly linked with the domestic markets in primary production, supply in return, and subcontracting activities, and in the defence chains as middleman and trader activities.

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MANAGEMENT AND TECHNOLOGY: OPTIMIZING SUPPLY CHAIN EFFICIENCY IN THE APPAREL INDUSTRY

Dr. Gallayanee Yaoyuneyong, The University of Southern Mississippi, USA
gallayanee.yaoyuneyong@usm.edu
Dr. Mary Ann Moore, Florida State University, USA
mmoore@fsu.edu

ABSTRACT

This paper first presents a summary of traditional color supply chain management in the apparel industry. Next, the paper outlines the supply chain problems that cause loss of time and waste of production runs. Following that, the paper outlines the ways in which digital color description and online digital communication vastly reduce time-loss from transit and from error. Next the paper discusses ways to use spectrophotometer readings to boost sales and customer satisfaction while simultaneously minimizing the risk of fully or partially wasted production runs. A account is given of spectrophotometer research conducted by the authors, along with an explanation of the interaction between common illuminants (A, D65, and F02) and three naturally colored cotton fabrics (light brown knit, dark brown woven, and green woven).

Key Words: supply chain management, supply chain efficiency, apparel industry, color management and communication,

INTRODUCTION

In any industry, management of the Supply Chain is a critical factor in achieving success. This is true even for markets such as the fashion industry, where operations and manufacturing are often considered to be secondary to marketing activities (3). For example, in 2000, the textile and apparel industry lost $34 billion in waste due to its supply chain methodology (9). Time spent communicating with suppliers during the design and development stage accounted for 20% of that figure (9). The single largest factor impeding textile and apparel retail development is color management, which is the process of controlling color from the concept design stage all the way to the sales floor and the end consumer (18). Color management is a process which is highly affected by management decisions regarding the finding and adoption of new and appropriate technologies.

COLOR MANAGEMENT AND COMMUNICATION

Color has always been one of the very first steps in the process of apparel production. Moore et al. (18) identified textile color management as the process of controlling color from concept design through sale to the ultimate consumer. The process includes color creation, lab dips, design, color manufacturer approval, and merchandise display. In the past, the designer would start by determining the right color for their design. The right color can be taken either from nature (i.e. the color of a bird, or leaf, or fruit) or from materials (i.e. a certain paper, a specific plastic). Next, the designer would mail the color standard, or color sample (which would often be

a leaf, or a plant stem, or a paint chip) to the manufacturer or vender so they can provide physical lab dips (sample pieces of fabric which show the color or colors which will actually be produced). Once the physical lab dips are ready, the vendor mails them back to the designer, so the designer can check the color quality and its match to the original color standard. Most color measurement in the past was only done by visual assessment. Comments about the color, and requests for changes or alterations, were then communicated by express mail, fax, email, and telephone, since both sides could be located in different time zones.

PROBLEMS IN THE COLOR SUPPLY CHAIN

The textiles and apparel industry has had to deal with a market that is increasingly volatile, unpredictable, consumer driven, and dominated by impulse buying behavior; to address these market characteristics, manufacturers have needed to become more competitive and much quicker to react by producing items with much shorter product lifecycles (3, 6, 16). Recently, the textiles and apparel industry has also had to deal with enormous changes in global sourcing and high price competition (3). Because of its complexity and dynamics, many researchers have focused their studies on the area of operations and supply chain management (3, 4, 6). However, only few industry articles concentrate on management and communication in the color supply chain (8, 9, 19). Unfortunately, the single largest factor impeding textile and apparel retail development is color management, which is the process of controlling color from the concept design stage all the way to the sales floor and the end consumer (18). Problems in color management and communication may arise anytime in the production process.

Time Wasting in Color Management and Communication

Due to the changing nature of the fashion market, products are generally marketable for only a few months. This short timetable places strain on the management during each stage of the supply chain (17). As a consequence of this, management of supply chains has been a complex challenge all across the board for global retail chains such as Macy's, Gap, and Bulk (17). Other supply chain problems center around the difficulty in insuring that quality standards are met during each step of the process that leads to a finished product. It is not unheard of for entire product orders to be found unsellabe due to management oversight during only one step of the production process. Unfortunately, color is an incredibly difficult aspect to successfully manage, especially under a tight timetable, since the process is complex and including many steps. Significant amounts of time are spent in mailing samples, substrates, and lab dips, and in exchanging comments and attempting to verify approval. The period in which color items and communications are mailed back and forth sometimes accounts for most of the production time.

Inexact Results of Color of the Products

Since mailing time is often lengthy, the physical sample of the original color (i.e. a leaf) may change its color by the time it arrives. Furthermore, in the production of color, describing color has always been subjective, with modifying words such as: "warmer", "brighter", and "bluer", having ambiguous meanings, only matched by the lack of precise definitions for common starting points (i.e. fire-engine red, sky blue). The expense of the mailing process, for all parties,

as also frequently led to cost cutting by cutting communication. This experience is even more difficult when suppliers and manufacturers are in difference time zones, or are facing language and cultural barriers. The cost of color communication is approximately $50-70 per color approval cycle, and colors usually go through an average of 3 to 5 cycles before being approved (9).

Inconsistency in color from one link on the supply chain to the next leads to difficulty in making management decisions about what colors to aim for, or request, when trying to match specific apparel products (7). Color variations causing by different in substrates (components, surfaces, textures) and in dyelots will initiate the inconsistency between partners and venders as well. There is a challenge of obtaining the same shade of color on different materials. Establishing workable and interpreting tolerances for color become an issue that can cause the color inconsistency. Also, once a color is chosen, communication problems in the color manufacturing approval process, as well as the possible necessity for multiple lab dips, can cause time delays which can push back production deadlines, perhaps critically (7).

Additionally, the study of Moore et al. (18) revealed that more than half of the respondents (60%) do not either require either the room or fabric specimens to be conditioned. Since fabrics as well as color can vary in their response to the changing of temperature and humidity conditions, it is essential to specify and control these environment conditions for minimizing color variations of specimens being evaluated in the color measurement process (5). Even the respondents who require the specimens to be conditioned, only 16.7% use a conditioned room with temperature and humidity controlled. Variations of color originating by diverse environment conditions between different parts of the world may cause a significant inconsistent color results.

Unsold Products

Many retailing companies either have their own in-house color quality control department or outsource it. They would like to have the best and most accurate color for their products. They all have, for example, a color system for color matching, a color measurement instrument, trained observers, a color scale and a color perception system. They compare the color between their standard and their product in order to get the color that their designers initiate. In the retail industry, color is the first thing that draws a customer's attention to a product (1, 14). Unfortunately, there is no awareness that the illuminants in the retail store are different from that of the standard illuminant for the quality control process (1). There is more than one type of illuminant used in any location in a retail store (12, 13). Both incandescent and fluorescent lights have been widely adopted in retail stores (2, 12, 13, 20). Moreover, the lighting of their customers' household might be a dissimilar illuminant from the fitting room, the floor and the standard illuminants. The perceived color is the outcome of the intricate interaction between object and light source. Since three factors, object, light and human eye, are needed to perceive color, diversity of these three factors influences how people perceive color. This might create a color difference problem when customers inspect the color of the apparel products in different locations. As a result, customers return the merchandise. Also, the lighting in the sales areas

intends to initiate and complete sales transactions. Failing to recognize and corporate this in the supply chain management will result in unsold product.

SOLUTIONS

Digital Communication

Before the new technologies available today, supply chain management of color was limited, due to the limited effectiveness of communication. New technologies create the possibility of real-time supply chain color communication. The advent of digital files and digital communication has had a significant impact on the color approval cycle, which has in return reduced the production time necessary to get a product on the market (8, 9). Digital lab dips also available although less popular than the physical one. Once both parties realize that electronic lab dips is complete and accurate, the increasing of the popularity will arise.

In addition, the web-base solution is the latest advance in color technology (19). Through the web-base solution, everyone throughout the supply chain will have an opportunity to access it. Color communication both correction and approval will be optimally delivered by electronic system. The most powerful tool as an inclusive aspect of the new electronic environment is the ability to communicate digitally and assessed visually in condition that all the viewers have the same type of computer monitor that has been calibrated for color accuracy and utilizing the same color system. Besides enhancing the color communication, this will help minimized waste, and reduce raw material costs. Furthermore, application of appropriate technology and management practices greatly reduces color-matching time and raw material costs, due to the reduced need to mail swatches and substrates (9, 19).

Spectrophotometer

The modern spectrophotometer has taken decades to be invented. French scientists had drawn the preliminary sketches for a spectrophotometer in the 1890s but the technology of that time was insufficient to build one. Not until 1939 that Arnold O. Beckman, the American Chemist finally finished developing the modern spectrophotometer (21). The early spectrophotometer was invented before World War II and was used during the war by the government to check for food poisoning and for experiments to make atomic bombs. The invention of the spectrophotometer has impacted a wide range of fields from physics to chemistry and has led to the discovery of unknown properties of light.

Although research spectrophotometers had been in existence for many years, the first spectrophotometer to have a significant impact on color technology was the instrument developed and perfected by Professor Arthur C. Hardy in the Physical Department of the Massachusetts Institute of Technology and introduce by the General Electronic Company in 1928 (10, 11, 15). The alleviation for manufacturers in some of the difficulty of the subjective describing and expensive process by measuring the physical standards with a spectrophotometer then communicate to other locations with the data from spectrophotometer in the 1980s (19).

Spectrophotometers also offer a series of color difference formulas or scales, whiteness index, illuminants, degree of observers, shade sorting and geometry. Also, spectrophotometers record the date and time of color measuring and provide a data log of its memory. Moreover, the information provided by spectrophotometers is diverse such as spectral and tristimulus values, color rendering, total color differences, two or three dimensional graph and color tolerance (pass/fail) depending on the users' purpose of exploiting this instrument. Today's spectrophotometer has been advanced in the recent years that now the wireless portable one has been introduced and become popular. It contains software that can be directly connected to the web-base solution. Different standard illuminants defined by International Commission on Illumination (Commission International de l'Eclairage or CIE) also include in each spectrophotometer but the choices of available illuminants will depend on the brand of spectrophotometer. Therefore, it is convenience and easy to measure colors in different light by selecting that option. Color management is a process which is highly affected by management decisions regarding the finding and adoption of new and appropriate technologies.

A randomized factorial laboratory design was used. The independent variables were three naturally colored cotton fabrics (light brown-knit, dark brown-woven, and green-woven) as well as three types of illuminants (A, D65, and F02). Dependent variables consisted of value (L^*), the redness-to-greenness dimension of color (a^*), and the yellowness-to-blueness dimension of color (b^*). The total number of specimens was 30; with 10 specimens per color. Four measurements were taken on each specimen; two times in the vertical direction and two times in the cross direction (90° from the original position). The CIELAB color formula was used for color measurement. Analysis of Variance and Duncan's post-hoc analysis were used to analyze the effect of illuminants among the three fabrics with respect to the three dimensions of color.

With all three illuminants, (A, D65, and F02), the green fabric had the least color change across the illuminants. Considering value (L^*), the light brown knit fabric had the greatest color change under all three illuminants. The dark brown fabric had the greatest a^* and b^* color changes with respect to all three illuminants. However, the differences between the dark brown and light brown fabrics were only slightly distinct. The Duncan's post hoc analysis for three different illuminants resulted in statistically significant differences for all three dimensions of color. This result emphasizes that the green fabric is primarily responsible for the interaction between fabrics and illuminants.

Results of this study emphasize that using one illuminant in instrumental color measurement does not provide adequate or accurate color quality control since retailers use multiple types of illuminants in their stores. If multi-illuminant color testing is not conducted, color change of the product can lead to customer dissatisfaction which may result in dropping sales or an increase in merchandise return as the customers notice color differences under different illuminants. If this occurs, all the work and money invested in the supply chain would have been spent in vain. However, if retailers and their suppliers find out about an unacceptable degree of color change in their product under different illuminants ahead of time, through multi-illuminant color measurement, they can establish working tolerances in the color inconsistency for each color. This will insure the possibility of sales in the targeted stores. Ultimately, this study demonstrates

that one more step added to the management process for apparel and textile supply chains can significantly improve outcomes.

CONCLUSION

Although the majority of supply chain problems, in the apparel industry, have to do with imprecise and cumbersome methods of communication, another critical problem is the fact that entire production runs can go forward only to end up with products which end up being unsellable. In regards to the first problem, it is clear that organization decision-makers should examine the method of communication, both within the organization and within the organization's supply chain. The goal should be to find areas where current technology solutions can fill existing gaps. In the case of the apparel industry, digital color codes, along with instant digital communications online, combined to streamline the product color management process, provided that the company chooses to interact with businesses with comparable communications abilities.

When faced with huge problems, such as the waste of entire production runs, or the waste of significant portions of production runs, technological solutions should be devoutly sought. In this instance, the idea of using the spectrophotometer, both to manage color control during the production process and to pick product colors that are aesthetic under the lighting conditions of the sales floor, ended up solving most apparel supply chain problems. This solution may seem obvious, but it only appears so in hindsight. It has always been obvious in the past to send paint chips, pressed leaves, and other low-tech methods of color communication, back and forth, through the mail. It took a flash of insight to apply digital color to the apparel industry. This opened the door for effective and fast digital color communication. Additionally, with the ability to take color and light measurements becoming more affordable, it becomes possible to make another leap forward. Analyzing the light at the sales floor, and being able to accurately and precisely convey that information is part of the solution. Analyzing the performance of different types of fabric and different colors of fabric, under the predicted or measured sales-floor conditions, as well as under common lighting conditions (domestic lighting, sunlight, etc.) allows for choices that prevent wasted production runs. In the end, the moral is this: The problem may be big, but it may have a simple solution. The way forward is to search for the appropriate technological solution, even if it means examining the technologies of other fields.

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THE RELATIONSHIPS AMONG AND SUPPLY CHAIN PARTNERS AFFECTING INTERNAL OPERATION: PERSPECTIVES FROM THE HIGH-TECH ELECTRONIC MANUFACTURERS IN THAILAND

Dr. Rapee Kanchana, Rajamangala University of Technology Thanyaburi, Thailand
rapee.k@en.rmutt.ac.th

Dr. Kris M Y Law, The Hong Kong Polytechnic University, Hong Kong
mfkris@inet.polyu.edu.hk

Assoc. Prof. Dr. Kongkiti Phusavat, Kasetsart University, Thailand
fengkkp@ku.ac.th

ABSTRACT

The purpose of this paper is to capture and understand the viewpoints on the relationships among internal operations and supply chain partners (customers and suppliers) from managers and executives of the companies operating in Thailand. The electrical and electronics industry is selected for this study due to its importance to the national economy. The survey, developed by Law and Pujawan (2009), was used to gather the opinions from top executives of 32 manufacturers. Extensive statistical analyses are also employed. The overall findings indicated that participating manufacturing firms perceived the linkage internal operations has positive correlated with their suppliers and customers significantly. Effective internal operations positively influence the level of collective efficacy. Thai companies appear to place higher importance on the relationships with customers and suppliers. This is probably due to poorer ICT infrastructure and lower predictability in processes and operations. There is a need to adapt some of the available standards such as COBIT for ICT-related projects and initiatives, and to utilize the Capability Maturity Model as a roadmap to help strengthen Thai supply-chain operations.

Key words: supply-chain management, schedule nervousness, collective efficacy, internal operations, and customer and supplier relationships

INTRODUCTION

In an increasingly dynamic and competitive economic context firms, including, small and large companies, need to adapt their activity and strategies to their environment. Confronting with the challenges of changes in scheduling which is regarded as a critical issue for a timely delivery of products (Chakraborty and Sushil, 2007; and Wu, 2009). Given the pressure to balance among cost competitiveness (to overcome competition), responsiveness (to serve customers), and flexibility (to ensure own competency), many companies have focused on achieving significant and competitive advantage by configuring and managing the supply chain process and operations with their supply chain partners (Kumar and Liu, 2005; and Gunasekaran and Ngai, 2007). Suppliers have been increasingly perceived as an important strategic partner because of their impacts on a company's short- and long- term successes (Blanchard, 2008). If a supplier fails to

provide incoming parts or delivery services on time, this will likely lead to poor customer services and will subsequently add cost to an entire supply chain. At the same time, when developing new products, a great deal of consideration must be given to a supplier's ability to come up with a new part on-time with a required volume and quality (Silva, 2008). In other words, supplier management represents a critical task that needs to be compatible with a company's strategic goals (Pagell and Krause, 2002; and Steiner, 2008). In the past, supplier management tended to focus on contractual agreements with an emphasis on cost, known as a cost- based contract (Hoehn, 2003). Since the early 1990s, time and flexibility have been added (Takala, 2002). In fact, Garfamy (2003) suggested that a backbone of a generic supplier-management needed to consist of at least five main categories: (1) quality, (2) service, (3) organization profile, (4) process management, and (5) a cycle time for key work processes.

One of the key challenges in managing supply chains is the uncertainty in contractual fulfilment to customers (Sridharan and Laforge, 1990; Zhao *et al*., 2001; and Hilletofth, 2009). This uncertainty can be referred to as scheduling nervousness. According to Kadipasaoglu and Sridharan (1997), frequent changes, considered as a source of schedule nervousness, in production plans could be disruptive, and might subsequently lead to order acceleration, postponement, and/or cancellation. The schedule nervousness is expected to impact the performance level as well organizational competitiveness in the global market. Based on Blackburn *et al*. (1987) and Pujawan (2004), the uncertainty within supply-chain interrelationships could be attributed to various factors such as scrap, production overruns, variations in vendor lead times, and machine breakdowns and tooling problems. These constant changes in production schedules can have many negative impacts. They are: (1) undermining management's confidence in supply-chain operations, (2) causing disruptions in production or deliveries, (3) resulting in more adjustments on personnel, machine set-ups, (4) increasing inventory, premium freights, and (5) creating extensive record keepings. Furthermore, the report[1] published by Office of Small and Medium Enterprises Promotion under Ministry of Industry in Thailand openly suggested a need to capture and portray the viewpoint of managers and executives on their supply-chain interrelationships. Otherwise, governmental interventions in improving supply-chain competitiveness would be worthless.

PROBLEM BACKGROUND

In Asia, important industries for the country's economy can be quite a few. Namely, they are automotive, electronics, garment, food, and others. For examples, despite the 2005 survey conducted by the United Nations' Commission for Trade and Development that cites Thailand as the 3rd most attractive Foreign Direct Investment location in Asia, the need to continuously improve manufacturing competitiveness is still required (Manasserian, 2005). Based on several in-dept analyses sponsored by the Federation of Thai Industries (FTI), there is a clear urgency on improving supply-chain management across industrial clusters, especially electrical and

[1] The White Paper on Small and Medium Enterprises of Thailand in 2003 and Trends for 2004 prepared for Ministry of Industry, the Royal Thai Government

electronics, and automobile and automotive parts[2]. In order to achieve this improvement, it is important that awareness on how supply-chain interrelationships are perceived by manufacturers is critical. This understanding is expected to help prepare policy initiatives and action plans to help strengthen the competitiveness within the FTI's trade associations or industries[3]. Furthermore, public agencies, especially Department of Industrial Work, have expressed the need to understand what managers perceive as important relationships for their supplier management. Only with this understanding, proper and viable plans can be formulated to support supply-chain operations.

Give the above discussion, synchronizing the tasks on scheduling and planning among companies in a supply chain is important to ensure high performance (Pujawan and Kingsman , 2000; Pagell and Krause, 2002; and Pujawan, 2004). Considering the complexity and impacts of the schedules on supply- chain operations, the implications of scheduling nervousness is needed. This study is expected to help supply-chain operations in several ways (Kadipasaoglu and Sridharan, 1997). First of all, future research can be conducted to accurately reflect the need of managers and executives. Secondly, sharing the perception reveals potential concerns, alarms, or problems to managers and executives alike when managing supply-chain operations. This knowledge will possibly lead to several future studies; e.g., (1) best practices to help overcome difficulties and obstacles expressed by managers and executives— sharing and transfer, (2) policy initiatives and action plans from manufacturers to their suppliers when optimizing the performance levels in an entire chain, and (3) policy initiatives and action plans from relevant public agencies for continuously improving supply-chain operations.

OBJECTIVES

This research examines the perception of managers or executives on their supply-chain interrelationships. Given the need to maintain the competitiveness of the primary industries, the study focuses on the companies operating in the electrical and electronic sector. This examination is expected to help provide preliminary inputs into how Thai companies can improve their performance and supply-chain management. This knowledge is critical to the Thai Department of Industrial Work.

RESEARCH METHODOLOGY

For this study, the survey developed by Law and Pujawan (2009). The survey's details can be described as follows. The first component gathers respondents' demographic and company-specific information. The second component solicits the data on internal operations. The third component focuses on the relationships with suppliers and customers. The fourth component deals with the collective efficacy. The questionnaire applies the 5-point Likert scale where the level 5 corresponds to the strongly- agree category. See Table 1 for the survey items.

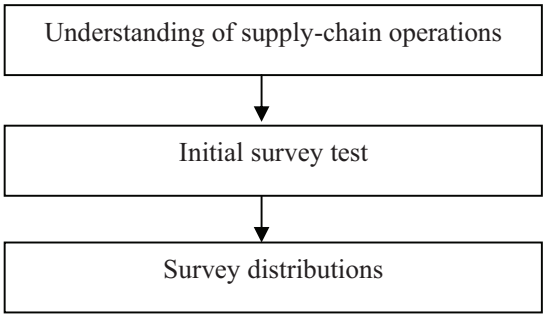
[2] In reference to the presentation on February 28th, 2006— Thailand Detroit of Asia: Master Plan for Thai Automotive Industry for 2006-2010 by Thailand Automotive Institute on behalf of all industrial clusters within the Federation of Thai Industries

[3] In reference to the report on Critical Assessment into Industrial Restructuring in Thailand, Ministry of Industry

Table 1: Survey Items

Internal Operations (IO)
IO1: Reliable production/ service delivery system
IO2: Materials/components commonality
IO3: Flexible planning system
IO4: Skilful and able planning staff
IO5: Good operations management
Relationships with suppliers (RS)
RS1: Flexible suppliers in delivery
RS2: Reliable suppliers with on-time delivery
RS3: Suppliers are willing to share information
RS4: Effective information and communication infrastructures of suppliers
Relationships with customers (RC)
RC1: Availability of information by customers well in advance
RC2: Customer's commitment to the agreed order
RC3: Customers are collaborative and willingness to share
RC4: Customers with effective information and communication infrastructure
Schedule Nervousness (SN)
SN1: Impacts on business performance
SN2: Time and resources devotion to schedule nervousness
SN3: Significant costs due to schedule instability
SN4: Impacts inventory handling management.
SN5: Impacts on management's confidence in our company's scheduling system
Collective Efficacy in Performance (CE)
CE1: Scheduling efficiency
CE2: High level of excellence
CE3: Goals achievement
CE4: Good relationships with suppliers
CE5: Good relationships with customers with better services

The survey instrument is earlier pre-tested for its content validity by two experts prior to distribution. The responses are evaluated statistically by using the SPSS. Cronbach's Alpha is to be used to assess the scale reliability. The Alpha of every factor needs to be more than 0.70— considered as a good statistical result (Johnson and Wichern, 1998). The high value of α suggests the high level of the data's internal consistency. The correlation analysis was also applied to examine the relationships among factors. There are three areas to be focused: (1) internal operations, and customers and suppliers within a supply chain, (2) collective efficacy and internal operations, and (3) schedule nervousness and key determinants— internal operations, relationships with customers, and partnership with suppliers. Furthermore, the analysis includes comparisons of the results with existing literatures with follow-up discussions. See Figure 1.



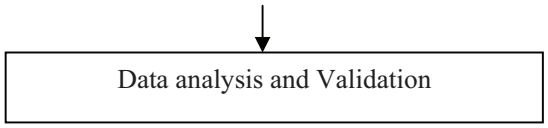


Figure 1: Research Methodology

RESULTS

The surveys were distributed during February 2009. The participating companies are approached by Department of Industrial Work with strong cooperation from the FTI. There are thirty-two manufacturers participating in this survey. They are generally regarded as a successful manufacturer with excellent reputation from their suppliers and customers. See Appendix A for the profiles of all participants. The mean scores and Cronbach's alpha were calculated and the overall results are provided in table 2. Because all values of α were greater than the minimum acceptable level, ranging from 0.736 to 0.848, this indicates an internal consistency in this study.

Table 2: Overall Results from the Surveys

Survey Items	Mean Scores
Internal Operations (α = 0.736)	**3.56**
IO1: Reliable production/ service delivery system	3.91
IO2: Materials/components commonality	3.47
IO3: Flexible planning system	3.47
IO4: Skilful and able planning staff	3.34
IO5: Good operations management	3.59
Relationship with Suppliers (α = 0.760)	**3.36**
RS1: Flexible suppliers in delivery	3.34
RS2: Reliable suppliers with on-time delivery	3.41
RS3: Suppliers are willing to share information	3.34
RS4: Effective information and communication infrastructures of suppliers	3.34
Relationship with Customers (α = 0.848)	**3.42**
RC1: Availability of information by customers well in advance	3.38
RC2: Customer's commitment to the agreed order	3.25
RC3: Customers are collaborative and willingness to share	3.50
RC4: Customers with effective information and communication infrastructure	3.56
Scheduling Nervousness (α = 0.832)	**3.58**
SN1: Impacts on business performance	3.66
SN2: Time and resources devotion to schedule nervousness	3.63
SN3: Significant costs due to schedule instability	3.41
SN4: Impacts inventory handling management.	3.75
SN5: Impacts on management's confidence in our company's scheduling system	3.44
Collective Efficacy (α = 0.806)	**3.56**
CE1: Scheduling efficiency	3.28
CE2: High level of excellence	3.22
CE3: Goals achievement	3.56
CE4: Good relationships with suppliers	3.81
CE5: Good relationships with customers with better services	3.94

Furthermore, the responses were subjected to one-way ANOVA to find out whether there was any significant difference in the perception on supply-chain interrelationships between small and large firms. The results indicate that there is no case worth noticing. Then, it can be denoted that the viewpoints on supply-chain interrelationships among two company sizes are identical. See table 3.

Table 3: Analysis on the perception on supply-chain interrelationships among small and large companies

	Internal Operation (IO)	Relationship with Suppliers (RS)	Relationship with Customers (RC)	Schedule Nervousness (SN)	Collective Efficacy (CE)
p-value	0.030	0.447	0.150	0.067	0.565

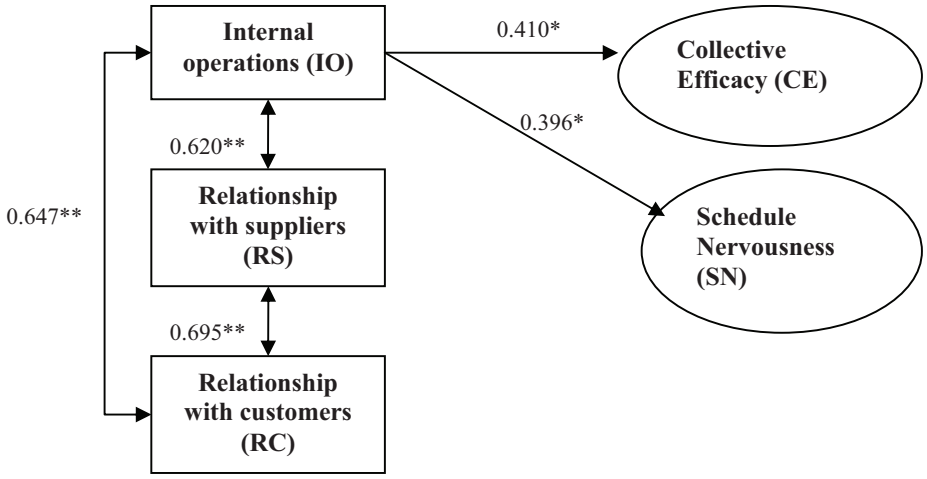
Note: Significant at the 0.01 levels

From the viewpoint of Thai managers and executives, the opinions expressed by participating companies can be summarized as follows. See both Table 4 and Figure 2.

Table 4: Inter-correlations Results

	Internal Operation	Relationship with Suppliers	Relationship with Customers	Schedule Nervousness	Collective Efficacy
Internal Operation	1				
Relationship with suppliers	0.620**	1			
Relationship with customers	0.647**	0.695**	1		
Schedule Nervousness	0.396*	0.285	0.380*	1	
Collective Efficacy	0.410*	0.402*	0.538**	0..561**	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).



** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Figure 2: Perception of Supply-chain Operations

DISCUSSION

The overall findings indicated that participating manufacturing firms in Thailand perceived the linkage the internal operating side of a business has positive correlated with their suppliers and customers significantly. This indicates that to strengthen internal operations, Thai manufacturers appear to focus more on building and maintaining the relationships with customers and suppliers. These findings appear to be consistent with the study conducted by Rungtusanatham *et al*., in 2003, Sarkis *et al*. in 2007, and Wu in 2009. They suggested that the internal operations can be benefited (in terms of increased productivity and improved quality) by working closely with suppliers as well as customers. One of the crucial lessons for Thai companies is the need to better utilize ICT to ensure effective supplier and customer partnerships for supply-chain operations and management. It is generally agreed that with better ICT integrations into management and operational processes of each partner, extra time and resources can be spent on improving internal operations and work processes (Ounnar *et al*, 2007; Hvolby *et al*, 2007; and Lummus, *et al*, 2008).

Despite several available standards for quality and customer safety (e.g., ISO 9001: 2008 and Hazard Analysis and Critical Control Points or HACCP), there is a lack of awareness on and integration of practical standards that help design, manage, deploy, and implement ICT- related projects and initiatives. In fact, top administrators from the FTI have openly expressed their concern that in spite of heavy ICT investments in recent years, there seems to be a lack of concrete changes and improvements in process/ work flows (i.e., internal operations) within an organization. Top governmental officials from Department of Industrial Work have strongly

suggested the applications of ICT-related standards such as Control Objectives for Information and related Technology or COBIT, and Projects in Controlled Environments or PRINCE to help strengthen ICT initiatives and projects among Thai companies. In other words, for the companies operating in key industries, there should be available standards for ICT-driven projects and initiatives so that they can improve their relationships with suppliers and customers, especially in the areas of communication, information transfer, tracking, and resource sharing.

It is important to point out that internal operations are perceived to cause more schedule nervousness (instead of the less impacts as expected). This unusual finding can be traced to the less predictability of internal operations. Based on the Capability and Maturity Model or the CMM, can be used to explain that most participating firms in Thailand are likely to be at Level 3. At the CMM's Level 3, internal and operational processes are not quantitatively controlled and managed in spite of existing instructions and procedures to help govern how the tasks are carried out by individuals (Blanchard, 2008). Therefore, a lack of confidence in process capability from the Thai participants can be expected (Robinson *et al*., 2006). This lack of confidence can subsequently lead to higher schedule nervousness. To increase the process predictability, one idea is to promote performance measurement as a key management tool (in addition to the ICT-related standards). The findings from Thai companies help underscore this promotion. In addition, some of well- known quality management-related awards such as the Malcolm Balrige, the European Foundation for Quality Management Award, and the Singaporean Business Excellence Awards on Quality advocate an important role of performance measurement.

Finally, the limitations of this research cannot be overlooked and need to be specifically pointed out. The sample size needs to be recognized and could have potential impacts on the findings. The stages in organizational life-cycle development (e.g., start-up, growth, maturity, etc.) are not specified when collecting the data. In addition, the analysis primarily focuses on the general level of individual subjects (e.g., collective efficacy, internal operations, schedule nervousness, etc.) without extensively looking at their detailed items as well as organizational profiles. Future studies should be conducted in regard to how different other profiles impact on the perception on supply-chain interrelationships such as targeted customers. Furthermore, a possible future study should explore and present the perceptions of supply-chain interrelationships in difference countries.

CONCLUSION

The research focuses on understanding the perceptions of supply-chain interrelationships from managers and executives of thirty-two Thai companies operating in the electrical and electronic industry. The overall findings indicated that effective internal operations not only positively correlated with suppliers and customers relationships but also positively influence the level of collective efficacy. These findings are generally consistent with previous studies. See Rungtusanatham *et al*., in 2003, Sarkis *et al*. in 2007, and Wu in 2009. The results appeared to support the overall policy by the FTI in the ICT- related projects and initiatives. One of the crucial lessons for Thai companies is the need to better understand and adapt ICT-related standards for future initiatives and projects, and to use the CMM as a roadmap to increase the

process predictability. These are important as the companies continuously need to strengthen their supply-chain operations and management in order to maintain business competitiveness.

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Appendix A: Details of Participating Companies

Table A.1: Demographic Details by Size (N = 32)

	Small and Medium Size	Large Size
Number of responses	5	27
Position in companies		
Top Managers	4	16
Middle Mangers	1	10
Lower Managers	0	1
Plant locations		
Other China cities	0	1
South East Asia	2	18
US or Canada	1	2
European countries	1	1
Other than the above	1	5
Business Nature		
OEM	0	6
OBM	3	16
ODM	2	3
Subcontracting	0	2
Key clients		
Industry	4	11
Consumer	1	16
Key Markets		
America	2	5
Europe	0	4
Korea	1	3
Japan	1	5
Hong Kong & China	0	1
Global market	1	9

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TECHNOLOGY ADOPTION OF MOBILE LEARNING IN LANGUAGE: A STUDY OF PODCASTING IN TAIWAN

Dr. Bruce C. T. Ho, Viola H. Y. Fang
Institute of electronic commerce, National Chung-Hsing University, Taiwan
viola821@gmail.com

ABSTRACT

Learning a second language has been emphasized significantly in the language policy of most countries. Podcasting is one of mobile technology's new applications. The purpose of this research is to find the development and application of Podcasting in mobile learning and to explore the factors which will influence the acceptance of applying Podcasting in language learning. Data were collected from 398 people using Podcast applications on a voluntary basis in Taiwan and tested a proposed conceptual framework based on Unified Theory of Acceptance and Use of Technology (UTAUT) with moderating variables. After performing satisfactory reliability and validity checks, the structural model was tested with the use of PLS. Results indicate that performance expectancy, effort expectancy, social influence, and facilitating conditions will influence behavioral intention, Also, the result indicates that effort expectancy, performance expectancy, social influence have a significant with the moderating variables.

Keywords: Unified theory of acceptance and use of technology (UTAUT); Technology acceptance; Podcasting; Mobile learning; Language learning;

INTRODUCTION

Research Background and Motivations

In the web2.0, the most popular application of digital broadcasting should be "Podcasting". Podcasting is the synthesis of two words, Apple Computer's digital multimedia player "iPod" and "broadcasting" (broadcast). A Podcast is a digital media file, or a related collection of such files, which is distributed over the Internet using syndication feeds for playback on portable media players and personal computers. In September 2004, Apple released iPodder, was seen as a sign of podcasts appear, but also podcasting start craze on the globe. And Oxford American Dictionary has been selected "Podcast" as the hot new word in 2005.

Business Week pointed out that in 2005 the podcasting platform has surpassed 3500 websites; moreover, the websites provide the podcasting service growing day by day. Like the blog (Blogger), subvert the way of passively accepted the writing information, podcast also subvert the way of passively listened to the broadcast. Google will be going to promote the audio search engine, if this rumor becomes really, without doubt it will accelerates the development of Podcasting. Perhaps, as the blog, Podcast possibly brings the mass media another revolution.

Learning a second language has been emphasized significantly in the language policy of most countries. Under this trend, language plays a critical role in allowing different people from different countries to share the same information. Due to this, the importance of languages has become a hot issue around the world.

For example, there is no doubt that English has already become an universal language, so learning English is getting more and more important in non-English speaking countries. In Taiwan, English is also the most popular second language. Learning English has already been a very hot issue, and people always talk about how they can improve their English, no matter what age they are. Almost every student is required to improve their English ability from elementary school to graduate school.

Nowadays, information technology improves rapidly, and this improvement does greatly help people to learn more. That means maybe IT can also solve English learning problems, so this research tries to figure out whether IT can help or not.
Podcasting, a new IT application, can get information automatically over the internet via publishers and subscriber models by using RSS technology (Really Simple Syndication, a XML-based transmission system). In Taiwan, there are some broadcasting companies using Podcasting to broadcast their programs. So far, most Podcasting websites are personal websites, such as articles and lectures by single individuals. Actually, Podcasting is a very new concept in Taiwan. But in other countries, Podcasting is applied in very different ways including education, traveling, and language learning, and so on. For example, Stanford University uses Podcasting to deliver messages to their students and staff, and many other universities also do so. There are also a lot of language-learning websites using Podcasting to help people learn a language around the world, and this means it does have the potential to help people learning a language. Once people accept Podcasting, it could be a very useful language learning tool.

LITERATURE REVIEW

Podcasting

The term "Podcast" is a portmanteau of the words that was invented in 2004. It combines the words "iPod" and “broadcast”. A Podcast is a digital media file, or a related collection of such files, which is distributed over the Internet using syndication feeds for playback on portable media players and personal computers.

Podcasting is a term that was devised as a crisp way to describe the technology used to push audio content from websites down to consumers of that content, who typically listen to it on their iPod or other audio player that supports mp3 at their convenience. The term podcasting is meant to rhyme with broadcasting and is a derivative of the iPod platform. While not directly associated with iPod device or iTunes music service, the company did contribute both the desire and the technology for this capability. Podcasting is not unlike time-shifted video software and devices like TiVo, which let you watch what you want when you want by recording and storing video, except that podcasting is used for audio and is currently free of charge. Note, however, that this technology can be used to push any kind of file, including software updates, pictures, and videos.

Podcasting uses an XML-based technology called RSS, or Really Simple Syndication. Content publishers describe new content in an XML RSS file which includes dates, titles, descriptions, and links to MP3 files. This auto-generated file is called an RSS feed. The key to making podcasting work with RSS is enclosures, a feature supported by RSS 2.0.

Meng[13] defines podcasting as “the process of capturing an audio event, song, speech, or mix of sounds and then posting that digital sound object to a Web site or “blog” in a data structure called an RSS 2.0 envelope (or feed)”. According to these definitions, podcasting can be characterized with two main features:

1. Podcasting is an audio content delivery approach based on Web syndication protocols such as RSS and/or Atom.
2. Podcasting aims to distribute content to be used with mobile and digital audio/video players such as iPods including all other MP3 players, cell phones and PDAs.

So we can formulate podcasting as following:

Podcasting = *Web syndication (RSS, Atom) + Audio content (talk shows, music, news, and certainly learning resources…) + Mobile devices (mp3 players, PDAs, cell phones…)*

Mobile Learning

The use of computing technology for learning has been observed in various ways, but since the recent years quick advance of mobile technologies a new term has appeared – mobile learning. Mobile learning is a field which combines two very promising areas – mobile computing and e-learning. M-learning has been considered as the future of learning or as an integral part of any other form of educational process in the future.

Mobile learning (m-learning) is the follow up of e-learning, which for its part originates from distance education. The term ‘‘m-learning’’ has lately emerged and is associated with the use of mobile technology in education. Mobile learning, or m-learning for short, is a new concept, and is very closely related to e-learning. Stone [19] defines m-learning as a ‘special type of e-learning, bound by a number of special properties and the capability of devices, bandwidth and other characteristics of the network technologies being used’. Milrad[14,19] defines e-learning as ‘learning supported by digital electronic tools and media’, and m-learning as ‘e-learning using mobile devices and wireless transmission’.

M-Learning is often defined as learning that takes place with the help of portable electronic tools [17]. A portable device that supports learning may be freely moved, but learner is mostly stationary, even though they are using a mobile device.
Although the device is mobile and portable, the learning as an event cannot be described as mobile [1]. Moreover, when people access information via different tools, there is still much usability, compatibility and accessibility related questions that hinder seamless mobility and m-learning.

The point at which mobile computing and e-learning intersect to produce an anytime, anywhere learning experience. M-learning refers to the delivery of learning to students anytime and anywhere through the use of wireless Internet and mobile devices, including mobile phones, personal digital assistants (PDAs), smart phones and digital audio players. Namely, m-learning users can interact with educational resources while away from their normal place of learning—the classroom or desktop computer. The place independence of mobile devices provides several benefits for e-learning environments, such as allowing students and instructors to utilize their spare time while traveling in trains or buses to finish their homework or lesson preparation[2]. If e-learning took learning away from the classroom, then m-learning is taking learning away from a fixed location.

Mobile learning (m-learning) inherits these advantages from e-learning, but extends their reach by making use of portable (handheld) wireless technologies. Suitable devices include digital media players (e.g. iPods, MP3 players), smartphones (e.g. Blackberry, iPhone), and Personal Digital Assistants or PDAs (e.g. Palm, Pocket PC). One of the key benefits of these devices is that they allow learners to vary their study location and to study ‘‘on the move’’[15]. Motiwalla [15]contends that learning on mobile devices will never replace classroom or other e-learning approaches. Thus, m-learning is a complementary activity to both e-learning and traditional learning.

Unified Theory of Acceptance and Use of Technology (UTAUT)

In MIS research, there are many studies that have investigated user acceptance and usage of new IT. Many studies have used TAM or made changes to it. Other models, such as the theory of planned behavior (TPB), and social cognitive theory (SCT) are also well known.

Venkatesh and Davis [22] introduced an extension to TAM, TAM2, which examined the influences of select antecedent social influence and cognitive instrumental constructs on perceived usefulness and usage intentions. Models for technology acceptance and adoption including the technology acceptance model (TAM) [5], theory of reasoned action (TRA) [6], and innovation diffusion theory (IDT) [18] have been established and tested extensively. More recently, through reviewing and empirically testing the technology acceptance models, Venkatash *et al*. [23] proposed a unified model integrating acceptance determinants across several competing models. Referring to the UTAUT, Venkatash *et al.*’s model has been validated in empirical settings as having superior explanation power over past models. According to the UTAUT, intention to use the information technology (IT) can be determined by three antecedents: performance expectancy, effort expectancy and social influence and, as a consequence, intention to use is to exert influence on actual behavior toward IT adoption with facilitating conditions [23].

Venkatesh *et al.* [23] conducted an empirical study to compare the eight competing models and then proposed a unified model, UTAUT, which contains four core determinants of IT use behavior, and up to four moderators of key relationships (see UTAUT model). UTAUT posits that performance expectancy, effort expectancy, social influence and facilitating conditions are determinants of behavioral intention or use behavior, and that gender, age, experience and voluntariness of use have moderating effects in the acceptance of IT.
UTAUT postulates that four constructs act as determinants of behavioral intentions and usage behavior:

Performance expectancy: ‘‘The degree to which an individual believes that using the system will help him or her attain gains in job performance,’’ [23]. Performance expectancy measures how much people perceive a system, such as the Internet or mobile technology, is useful in achieving their goals in terms of job performance. The concept of performance expectancy, including perceived usefulness, has been considered the most powerful tool for explaining the intention to use the system regardless of the types of environments, be it mandatory or voluntarily.

Effort expectancy: ‘‘The degree of ease associated with the use of the system,’’ [23]. Effort expectancy explains how much people feel comfortable and find it easy to adopt and employ the system for their jobs.

Social influence: ‘‘The degree to which an individual perceives that important others believe he or she should use the new system. Social influence is system- or application-specific, whereas subjective norm relates to non-system-specific behavior,’’[23].
The last construct proposed as antecedents of the intention to use is social influence, i.e. the influence of others’ opinions about a certain system adoption. The findings of the effect of social influence has been mixed through the investigations of several studies because the concept of social influence is likely to be complex while involving compliance related to social pressure such as subjective norms as well as identification related to self identity standing for social status gains [22]. The effect of social influence depends on environmental characteristics such as mandatory or voluntary or in another perspective, individual base or organizational base [9,11,22].

Facilitating conditions: ‘‘The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system,’’ [23]. Facilitating conditions refer to how people believe that technical infrastructures exist to help them to use the system when needed. The four core determinants are shown in Table.1.

Table.1 The four core determinants of UTAUT

UTAUT Determinant	Sub-Dimensions	Original Theories
Performance Expectancy	Perceived Usefulness,	TAM/TAM2/C-TAM-TPB
	Extrinsic Motivation,	MM
	Job-Fit	MPCU
	Relative Advantage	IDT
	Outcome Expectation	SCT

Effort Expectancy	Perceived Ease of Use,	TAM/TAM2
	Complexity	MPCU
	Ease of Use	IDT
Social Influence	Subject Norm	TAM/TAM2/TPB-DPTB/C-TAM-TPB
	Social Factors	MPCU
	Image	IDT
Facilitating Conditions	Perceived Behavioral Control	TPB/C-TAM-TPB
	Facilitating Conditions	MPCU
	Compatibility	IDT

The moderators in UTAUT, there are four moderators including age, gender, experience, and voluntaries of use moderate the relationship in UTAUT. UTAUT proposed that gender would moderate the effect of performance expectancy, effort expectancy, as well as social influence. In terms of gender role, UTAUT expected males to be more likely to rely on performance expectancy when determining to accept a technology with his highly task oriented nature. On the other hand, female's technology acceptance may be determined mainly by effort expectancy rather than performance expectancy under cognitions related to gender roles. This moderating effect of gender has been replicated by several studies in the area of technology acceptance in a variety of technologies like web-based shopping [21], e-mail [8], Internet banking [12], and so on.

RESEARCH METHOD

Research Model and Research Hypotheses

The model for our study is presented as Fig. 1. It was derived from UTAUT, but was modified. The external variables are formed by the four core determinants in UTAUT model; the control variables are in accordance with the UTAUT model's variables, including gender, age, and experience. We examined the factors that promoted the use of Podcast only on a voluntary basis; we eliminated voluntary use as a moderating construct.

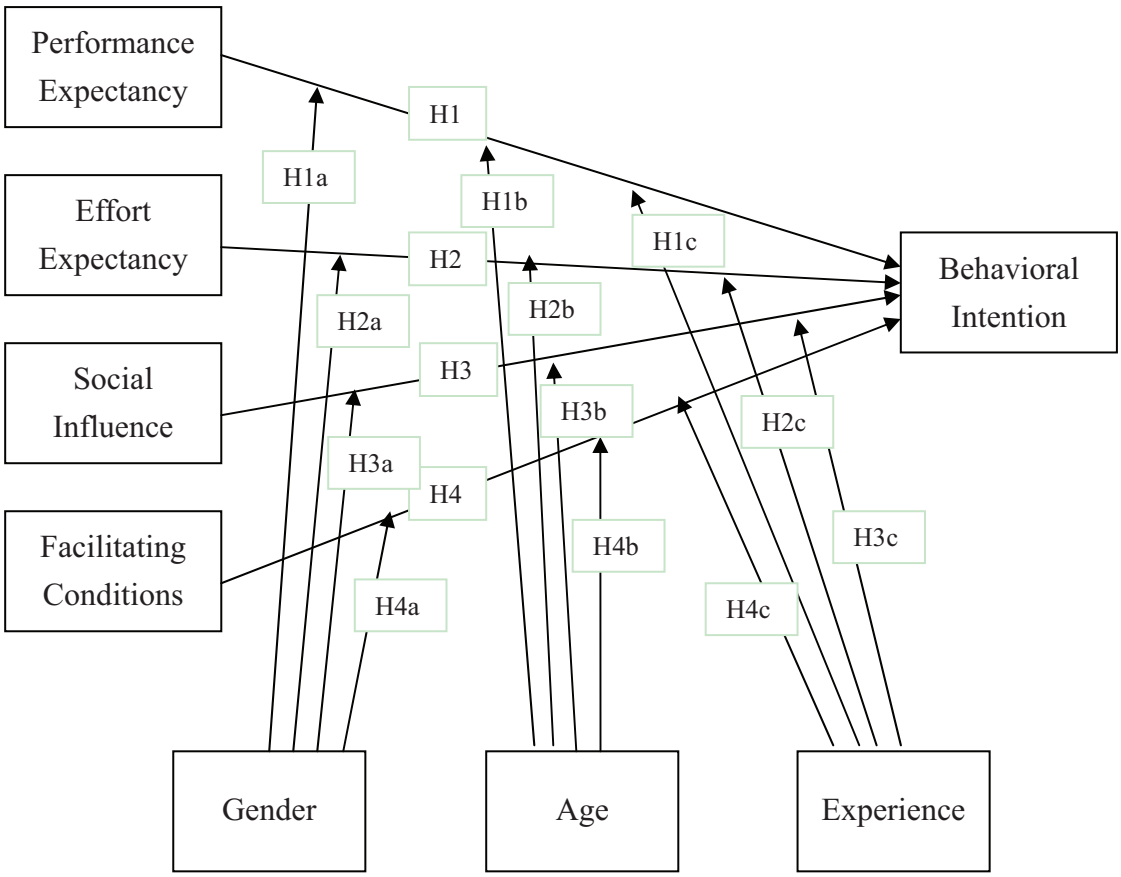


Fig. 1 Research Model

Performance expectancy

Language learners always care about their learning performance. If they wonder whether adopting a Podcasting system will help them to learn language, the effect of the system might be their consideration. Also, whether the Podcasting system could help them learn the language easier and faster might be another concern. Once they feel the Podcast system is useful to them, it might make them have the intention to use it. This construct tries to test if people think Podcasting is useful to them or not. It also tests whether people feel Podcasting will improve the learning quality and whether it will make their learning easier and faster.

H1: Performance expectancy will have an influence on behavioral intentions to use Podcast.

- H1a: Gender will moderate the influence of performance expectancy on behavioral intentions to use Podcast.
- H1b: Age will moderate the influence of performance expectancy on behavioral intentions to use Podcast.
- H1c: Experience will moderate the influence of performance expectancy on behavioral intentions to use Podcast.

Effort expectancy

Many researchers have proved that the complexity of a new technology will influence the acceptance of it. Once people feel they can operate or learn new technology easily, they will have stronger intention of using it. In a Podcasting system, compared to traditional learning methods, if people feel that it is easy to use and they do not need to put too much effort into learning it, they would be more willing to use it in language learning. If they think it will take them too much time to learn the Podcasting system, it will be meaningless to change the way of learning a language. This part tries to test if people consider that the operation of a Podcast is easy for them or not, and how they feel about learning and using a Podcast.

H2: Effort expectancy will have an influence on behavioral intentions to use Podcast.

- H2a: Gender will moderate the influence of effort expectancy on behavioral intentions to use Podcast.
- H2b: Age will moderate the influence of effort expectancy on behavioral intentions to use Podcast.
- H2c: Experience will moderate the influence of effort expectancy on behavioral intentions to use Podcast.

Social influence

Sometimes, the opinion of other people will affect one's action. In UTAUT, Venkatesh et al. have proved that the acceptance of new technology of people will be influenced by other people, and this kind influence will also affect the intention of using new technology. In this research, this section also wants to test whether people who intend to use a Podcast will be influence by their friends, boss/teachers or organizations they belong to.

H3: Social influence will have an influence on behavioral intentions to use Podcast.

- H3a: Gender will moderate the influence of s Social influence on behavioral intentions to use Podcast.
- H3b: Age will moderate the influence of Social influence on behavioral intentions to use Podcast.
- H3c: Experience will moderate the influence of Social influence on behavioral intentions to use Podcast.

Facilitating condition

If people want to use new technology, they should have the hardware, software, and knowledge to support it. Without these, they may not access that new technology, even though they really want to use it. Also, if someone can help them if they have problems using

it, it will also influence the use behavior of people on systems. This part tests whether people have enough resources or knowledge to use a Podcast, and also tests whether a Podcast can be compatible with other systems.

H4: Facilitating conditions will have an influence on behavioral intentions to use Podcast.

- H4a: Gender will moderate the influence of s Facilitating conditions on behavioral intentions to use Podcast.
- H4b: Age will moderate the influence of facilitating conditions on behavioral intentions to use Podcast.
- H4c: Experience will moderate the influence of facilitating conditions on behavioral intentions to use Podcast.

Questionnaire Design and Data collection

The questionnaire is based on the measures in our framework were adopted from the original UTAUT, and the items of the questionnaire in this research have been modified to fit the subject of this research. In the mean, the original ideas of items have not been changed, but some descriptions have been changed to make the meaning clearer. The measurement items were based on a 7 point Likert scale from strongly disagree (= 1) to strongly agree (=7). To test the hypotheses, Empirical data were collected through an online survey of questionnaires answered by Internet users.

In order to exclude alternative explanations and add the internal validity, we targeted the people who were familiar with media in the Internet environment as the samples. The survey was conducted within a one-month. The samples have been randomly selected, and all of them are anonymous. A total of 398 responses were received. Valid questionnaire were 316 sets. The target of the sample was limited to the people who have the experience of using Podcasting in Taiwan.

The user profile is summarized in Table 2, which indicates majority of them.

Table.2 Descriptive characteristics of respondents

Demographic Variables	Items	Frequency	Percent	Cumulative Percent
Gender	Male	151	47.9	47.9
	Female	164	52.1	100.0
Age	15-18	9	2.9	2.9
	18-23	143	45.4	48.3
	24-28	135	42.9	91.2
	29-36	26	8.2	99.4
	Over 36	2	0.6	100.0
Level of Education	Senior high school	10	3.2	3.2
	Undergraduate	216	68.6	71.8

	Graduate	89	28.2	100.0
Experience	Under half-a-year	96	30.5	30.5
	Half-a-year- one year	92	29.2	59.7
	One year-two years	94	29.8	89.5
	Two year-three years	28	8.9	98.4
	Over three years	5	1.6	100.0

RESULTS

The hypothesized model was tested with the use of Partial Least Squares (PLS). PLS is a structural modeling technique that is well suited for highly complex predictive models[24]. And PLS is a variance based latent variable structural equations modeling technique, which uses an estimation approach that places minimal demands on sample size and residual distributions [3]. The evaluation of the model fit was conducted in two stages [3,10]. First, the measurement model is assessed, in which construct validity and reliability of the measures are assessed. Second, the structural model with hypotheses is tested.

The measurement model

Reliability and convergent validity results are given in Table 6. The data indicates that the measures are robust in terms of their internal consistency reliability as indexed by the composite reliability. All constructs exhibited composite reliability and Cronbach's alpha greater than the acceptable level of 0.70 indicating that the measurement errors were relatively small [16]. Cronbach's alpha of the different measures range from 0.76 to 0.938, which exceed the recommended threshold value of 0.70. And the composite reliabilities of the different measures range from 0.83 to 0.94, which exceed the recommended threshold value of 0.70 [16]. We used convergent validity and discriminant validity to check construct validity. To assess the convergent validity of constructs, researchers using PLS report the internal consistency measure developed by Fornell and Larcker[7]. Average Variance Extract (AVE) can be checked for convergent validity. According to Table 3, each AVE of constructs is larger than recommended value 0.5. To assess discriminant validity, Fornell & Larcker [7]suggested the square root of AVE, which should be greater than the variances shared between the construct. According Table 4, each square root of AVE is larger than the variances shared between the construct. It can be validly interpreted as high discriminant.

Table.3 Reliability and convergent validity of the measurement model

Variable constructs	Cronbach's Alpha	AVE	Composite Reliability	R^2

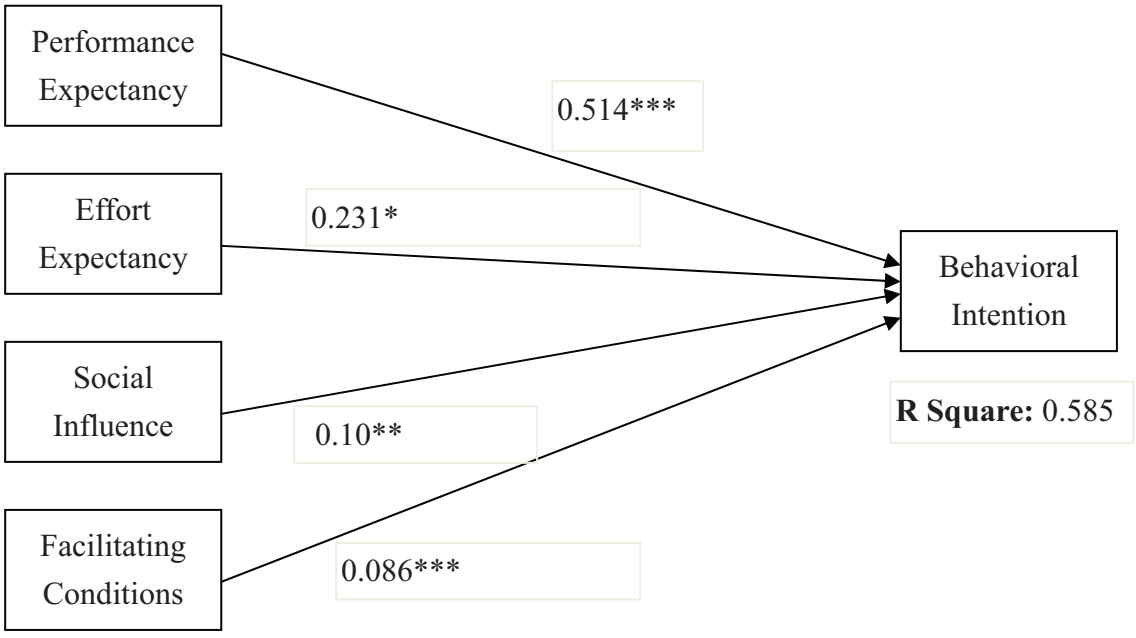
PE	0.916	0.798	0.941	
EE	0.938	0.844	0.956	
SI	0.780	0.512	0.835	
FC	0.765	0.593	0.849	
BI	0.912	0.745	0.935	0.585

Table.4 Discriminant validity of the measurement model

	BI	EE	FC	PE	SI	√AVE
BI	(0.863)					0.863
EE	0.672	(0.919)				0.919
FC	0.569	0.736	(0.770)			0.770
PE	0.737	0.731	0.606	(0.894)		0.894
SI	0.355	0.387	0.316	0.456	(0.715)	0.715

The structural model

Fig.2 shows the structural model results omitting the influence of the interacting moderator variables. All beta path coefficients are positive (i.e. in the expected direction) and statistically significant (at $p < 0.05$). To model the interaction effects, we conformed to Chin et al. [4]. Furthermore, we followed the hierarchical process that interaction terms were formulated by multiplying the corresponding indicators of moderator constructs.



* p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

Fig.2 Results of research model

Model Testing

The global criterion of goodness-of-fit (GoF) is an operational solution that provides the user deal with a global validation of the model in PLS path modeling [20]. A global criterion of goodness-of-fit (GoF) can be proposed as: GoF = square root of (average (AVE) * average (R square)). Average (AVE) is the mean of all AVE values of all Latent Variables and average (R square) is the mean of all R square values of all endogenous Latent Variables. Tenenhaus[20] suggested the recommend GOF value is over than 0.5. The GOF value is 0.64 in this research. It is greater than recommend value 0.5.

Moderating effects

In this research, we consider moderators included gender, age, and experience. We analyze interaction effects to determine the changes of situation to investigate more findings about user's behavior intention to use Podcasting. Table.5 shows the results of the structural model with interaction effects. It presents the results of the structural model with moderator variables.

Effort Expectancy*Gender and Facilitating Conditions*Gender of female have no significant effect on behavior intention at a significant level of 0.05. These results pointed out gender have no significant interactive effect with effort expectancy on behavior intention. And only gender of male has a significant interactive effect with facilitating conditions on behavior intention. Social Influence*Age over 24 has no significant effect on behavior intention at a significant level of 0.05.That younger people have stronger interactive effect with social influence on behavior intention. Effort Expectancy and Facilitating Conditions*Experience of under 1 year have no significant effect on behavior intention at a significant level of 0.05. Thus, these results pointed out user who has more experience have stronger interactive effect with effort expectancy and facilitating conditions on behavior intention.

Table.5 Interaction with Moderator

The Relationship of Variables	Path Coefficient		P-value	Significance
Performance Expectancy*Gender→ Behavioral intention	Male	0.427	***	Yes
	Female	0.557	***	Yes
Effort Expectancy*Gender →Behavioral intention	Male	0.183	0.165	No
	Female	0.279	0.86	No

Social Influence*Gender →Behavioral intention	Male	0.021	0.032	Yes
	Female	0.029	0.008	Yes
Facilitating Conditions*Gender →Behavioral intention	Male	0.16	0.042	Yes
	Female	0.011	0.82	Yes
Performance Expectancy*Age→ Behavioral intention	Under23	0.548	***	Yes
	Over 24-	0.496	***	Yes
Effort Expectancy*Age →Behavioral intention	Under23	0.337	0.024	Yes
	Over 24-	0.068	0.009	Yes
Social Influence*Age →Behavioral intention	Under23	0.043	***	Yes
	Over 24-	0.076	0.686	No
Facilitating Conditions*Age →Behavioral intention	Under23	-0.051.	0.010	Yes
	Over 24-	0.251	***	Yes
Performance Expectancy*Experience→ Behavioral intention	Under 1 year	0.487	***	Yes
	Over 1 year	0.515	***	Yes
Effort Expectancy*Experience →Behavioral intention	Under 1 year	0.295	0.176	No
	Over 1 year	0.130	0.002	Yes
Social Influence*Experience →Behavioral intention	Under 1 year	0.05	0.006	Yes
	Over 1 year	0.029	0.007	Yes
Facilitating Conditions*Experience →Behavioral intention	Under 1 year	0.016	0.506	No
	Over 1 year	0.154	0.024	Yes

* p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001

CONCLUSION

Discussion and Conclusion

The main purpose of this research is to investigate in Taiwan people opinions when using Podcasting, and find which factors motivate an individual to adopt podcasts in learning language. Four hypotheses tested were supported in this analysis:
H1, Performance expectancy has an influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$); H2, Effort expectancy has an influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.05$). H3: Social influence will have an influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.01$). H4: Facilitating conditions will have an influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$).

And interaction with moderators, H1a: Gender moderates the influence of performance

expectancy on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$). H1b: Age will moderate the influence of performance expectancy on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$). H1c: Experience will moderate the influence of performance expectancy on behavioral intentions to use Podcast.

H2a: Gender will moderate the influence of effort expectancy on behavioral intentions to use Podcast, no supported at statistically significant (at $p < 0.05$).H2b: Age will moderate the influence of effort expectancy on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.01$).H2c: Experience will moderate the influence of effort expectancy on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.01$). H3a: Gender will moderate the influence of social influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.01$).H3b: Age will moderate the influence of Social influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$).H3c: Experience will moderate the influence of Social influence on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.01$). H4a: Gender will moderate the influence of s Facilitating conditions on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.05$).

H4b: Age will moderate the influence of facilitating conditions on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.001$). H4c: Experience will moderate the influence of facilitating conditions on behavioral intentions to use Podcast, supported at statistically significant (at $p < 0.05$).

Performance Expectancy, Effort expectancy, Social influence and Facilitating Conditions have direct effects on the adoption of Podcasting in learning language in Taiwan. Moreover, Facilitating Conditions affects the intension of users' behavior. Compare with the research of Venkatesh *et al.*,[23]; from these results, we have learned that, without the interaction with moderators, Performance Expectancy, Effort expectancy, Social influence and Facilitating Conditions have the effort on Behavior Intention. But if Effort Expectancy interacts with Gender, it becomes an opposite result, Effort Expectancy*Gender has no influence on Behavior Intention. In this research, we find that Facilitating Conditions interacts with Gender; only male has a significant interactive effect with Facilitating Conditions on Behavior Intention to use Podcast. Male compared to female regarding that technical infrastructures exist to help them to use the Podcast. Social Influence interacts with Age; only age under 23 has an effect with Social Influence on Behavior Intention. That younger people have stronger interactive effect with environmental characteristics such as mandatory or voluntary or in another perspective, individual base or organizational base to use the Podcast. That younger people are more willing to accept new technology, and this is the same as the result of Venkatesh et al. Effort expectancy and Facilitating Conditions interacts with

Experience; only experiences over 1 year have significant interactive effect on Behavior Intention. The users of experiences over 1 year have strong feeling comfortable and find it easy to use the Podcast. People who have more experience of a Podcasting system will raise their behavioral intention of using a Podcast. This may result from the understanding of Podcasts so that people have higher intention to accept applying Podcasts on language learning.

Limitation and Future Research

The limit of this research is the current situation of Podcasting in Taiwan. Podcasting in Taiwan is not very popular because it was introduced to Taiwanese people just four year ago. The applications of Podcasting are just starting up in many fields. People may feel a little strange about this kind of application. Finally, this research is different from the original UTAUT model because the data is collected at one time. In the UTAUT model, their research belongs to longitudinal research, and it could reflect different opinions at different periods. The method used in the study is quantitative, using the documents to discover the factors and develop the questionnaire. And in the further study, suggest using the qualitative study method to interview the users face-to-face, thus evolving the conceptual factor to do further study.

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EXPLORING FACTORS AFFECTING NURSING E-LEARNING SUCCESS BASED ON INFORMATION SYSTEM SUCCESS MODEL

Dr. Chung-Feng Liu, Chia-Nan University of Pharmacy and Science, Taiwan
fredliu@mail.chna.edu.tw

ABSTRACT

E-Learning is thought of as an innovative approach to enhance nurses' care service knowledge. Extensive research has provided rich information toward system development, courses design and nurses' satisfaction with an e-Learning system. However, a comprehensive view in understanding nursing e-Learning system success is an important but less focused-on topic. The purpose of this research is to explore nurses' e-Learning system use intention and satisfaction relating to net benefits based on the modified DeLone and McLean's Information System Success Model (ISSM). The study used a structured, self-administered questionnaire and collected 208 valid nurses' responses from 21 of Taiwan's mid-and-large-scale hospitals (i.e. medical centers and regional hospitals) that have implemented nursing e-Learning systems. The result, after structural equation modeling (SEM) analysis, confirms that the ISSM is sufficient to explore the nurses' e-Learning use in terms of "Intention to Use," "User Satisfaction" and "Net Benefits." However, while the three exogenous quality factors (System Quality, Information Quality and Service Quality) were all found to be critical factors affecting "User Satisfaction," only "Information Quality" showed a direct impact on the "Intention to Use" the e-Learning system. This study provides useful insights for evaluating nursing e-Learning qualities as well as an understanding of nurses' intentions and satisfaction related to performance benefits.

Keywords: Nursing, e-Learning Systems, Satisfaction, Intention, Information System Success Model

INTRODUCTION

Enterprises regard "e-Learning" as a way to gain more information, effectively reduce training costs, and enhance learning results without time and space constraints (Shachtman, 2000; Fletcher, 2004; Nelson, 2003; Carnwell, 2000; Marki et al., 2000). Thus, organizations have established numerous internet- and multimedia-based learning systems. With the prevalence of the internet, e-Learning is not only a web-based information system but also a crucial change in education methods (Keller & Cernerud, 2002).

Medical organizations have always considered ongoing training as an important activity. Hospitals expect nursing personnel to possess greater expertise due to the changeful

regulations of National Health Insurance System and continuous adoption of advanced medical technology. These medical professionals need to tackle complicated tasks with urgency, so they have to learn a great deal of practical knowledge in a limited period of time to meet job needs (Young, 2003).

In most hospitals, nurse staffing is tight and the three-shift system makes traditional classroom (face-to-face) learning difficult to achieve. E-Learning can compensate for these problems in nurses' education. According to a latest national investigation conducted under Department of Health authorization (Hwang et al., 2005), 24.2 % of regional hospitals and up to 68.4 % of medical centers have adopted e-Learning in Taiwan, revealing a growing tendency for e-Learning-based professional nursing training. Many e-Learning-related studies have focused on technical aspects or course design; relatively few studies have examined the effectiveness and impact of e-Learning on nursing personnel from the perspective of "information system success." Therefore, this study examined at depth factors for successfully using nursing e-Learning systems, as well as the impact on "Intention to Use," "User Satisfaction," and "Net Benefits," based on the "IS Success Model" developed by DeLone & McLean (2003).

LITERATURE REVIEW

Information Systems Success Model

In 1992, DeLone & McLean introduced the well-known "Information Systems Success Model," which covers six evaluation indicators and the relationship between indicators. According to that study, six constructs influence "IS Success," including "System Quality," "Information Quality," "System Use," "User Satisfaction," "Individual Impact," and "Organizational Impact." The prevalence of PCs, complex business information systems, and booming information technology outsourcing have produced a remarkable change in users' attitudes toward using information systems. The support and service for specific information systems provided by their company or contractor, principally influences users' satisfaction and their intention to use the systems. Therefore, based on IS Success Model studies over the past decade, DeLone & McLean proposed a modified IS Success framework by introducing the "Service Quality" construct.

In DeLone & McLean's updated model proposed in 2003, "Individual Impact" and "Organizational Impact" are incorporated into "Net Benefits" to reveal use of information systems influence. DeLone & McLean still held that "Intention to Use" would be a better evaluation indicator than "Use." Many researchers conducted IS Success studies from a variety of perspectives, but the framework proposed by DeLone & McLean remains the most mentioned and adopted.

Nursing e-Learning

E-Learning has been defined in many ways by numerous scholars (such as Khan, 1997; Hall, 1997; Keller & Cernerud, 2002; Clark & Mayer, 2003; 2007). Clark & Mayer (2003) introduced a rather complete definition describing e-Learning as "training delivered on a computer (including CD-ROM, Internet, or Intranet) that is designed to support individual learning or organizational performance goals." Clark & Mayer (2003) proposed four design features for e-Learning. An effective e-Learning design 1) includes content relevant to the learning objective; 2) uses instructional methods such as examples and practice to help learning; 3) uses media elements such as words and pictures to deliver the content and methods; 4) builds new knowledge and skills linked to individual learning goals or to improved organizational performance.

Using Clark & Mayer's viewpoint, this study defines a nursing e-Learning system as "an information system that supports nursing personnel learning and training via internet or intranet in healthcare organizations." Based on this definition, such a system covers current e-Learning activities like training for a clinical ladder program, case studies, and healthcare education programs.

METHODOLOGY

Research Framework

After reviewing numerous IS-Success-related studies, DeLone & McLean proposed the well-known IS Success Model. This study set up a research framework enlightened by nursing- and information-management-related literature with proper evaluation variables chosen by experts and scholars from academic and practical circles (see Figure 1). This research adopted DeLone & McLean's view to use "Intention to Use" instead of "Actual Use" for predicting IS success.

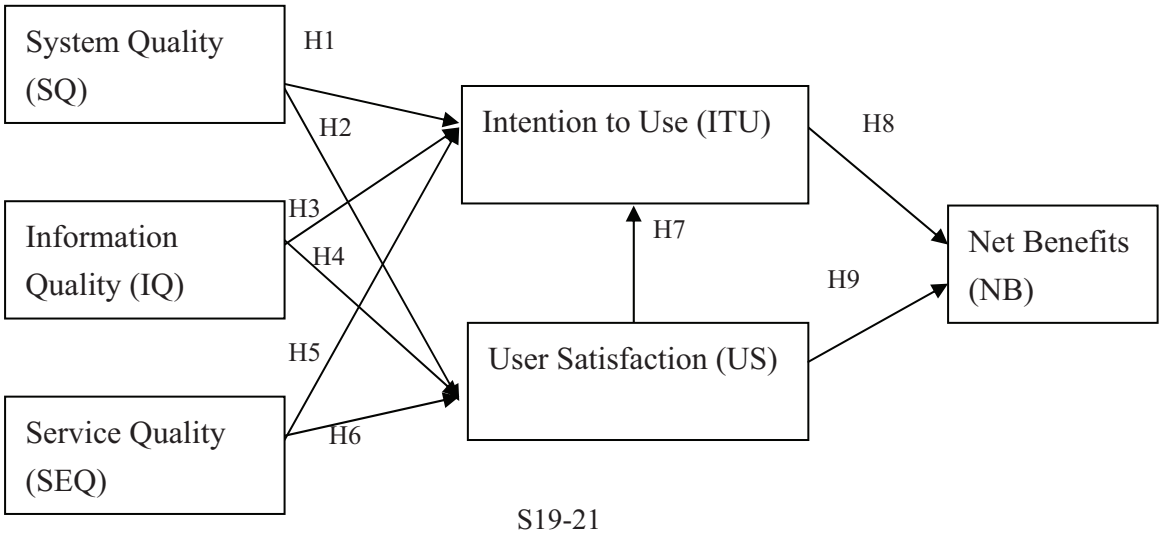

Figure 1. Research Framework

Research Hypotheses

In this study, "Net Benefits" of nursing e-Learning is thought to be influenced by "Intention to Use" and "User Satisfaction." "Intention to Use" also impacts "User Satisfaction." Nursing personnel's intention and degree of satisfaction toward e-Learning are both influenced by three constructs: "System Quality," "Information Quality," and "Service Quality." Therefore, this study puts forward the following hypotheses:

H_1: In a nursing e-Learning system, "Service Quality" significantly influences "Intention to Use."

H_2: In a nursing e-Learning system, "Service Quality" significantly influences "User Satisfaction."

H_3: In a nursing e-Learning system, "Information Quality" significantly influences "Intention to Use."

H_4: In a nursing e-Learning system, "Information Quality" significantly influences "User Satisfaction."

H_5: In a nursing e-Learning system, "Service Quality" significantly influences "Intention to Use."

H_6: In a nursing e-Learning system, "Service Quality" significantly influences "User Satisfaction."

H_7: In a nursing e-Learning system, "User Satisfaction" significantly influences "Intention to Use."

H_8: In a nursing e-Learning system, "Intention to Use" significantly influences "Net Benefits."

H_9: In a nursing e-Learning system, "User Satisfaction" significantly influences "Net Benefits."

Variables and Operational Definitions

This study deduced constructs and variables by compiling information from previously mentioned literature (DeLone & McLean, 1992; 2003) and comments made by experts and scholars. Exogenous variables encompass "System Quality," "Information Quality," and "Service Quality," while endogenous variables include "Intention to Use," "User

Satisfaction," and "Net Benefits." The questionnaire had 15 questions designed to cover the six constructs. Please refer to Table 1 for the compilation of constructs and operational definitions.

Table 1. Six Constructs and Operational Definitions

Construct	Variable	Operational Definition
System Quality (SQ)	Ease of use	An e-Learning system is easy to learn and takes little effort to master.
	Reliability	An e-Learning system seldom delays training due to a software or hardware crash or error.
	Usability	An e-Learning system provides pertinent service to facilitate daily training.
	Response time	An e-Learning system features quick responses, so long waiting will not hamper the learning activity.
Information Quality (IQ)	Completeness	An e-Learning system provides complete information that is relevant to the training.
	Accuracy	An e-Learning system provides accurate training information.
	timeliness	E-Learning provides timely and needed training information.
	Security	An e-Learning system protects learners' personal information from illegal disclosure.
Service Quality (SEQ)	Responsiveness	Information personnel immediately help nursing personnel with problems and requests regarding the e-Learning system.
	Assurance	Information personnel clearly understand nursing personnel's needs when using the e-Learning system.
	Empathy	In a nursing e-Learning system, the information personnel have nursing personnel's best interests at heart
Intention to Use (ITU)	Availability	Nursing personnel know the e-Learning system is easily available.
	Necessity	Nursing personnel feel the e-Learning system is necessary.
User Satisfaction (US)	Overall satisfaction	Overall, nursing personnel are satisfied when using the e-Learning system.
Net Benefits (NB)	Incremental efficiency	Using the e-Learning system increases nurse training efficiency.
	Incremental effectiveness	Using the e-Learning system increases nurse training effectiveness.
	Time savings	Using the e-Learning system takes less time to train nursing personnel.

This survey adopted a 5-point Likert scale, the content of which was based on questionnaire samples and pertinent theories proposed and verified by earlier researchers. A professor from

the information management field and two experts and scholars from the nursing field examined the first draft of the questionnaire. Five eligible nurses from a regional hospital completed a pre-test revised questionnaire to help discover and correct underlying problems in the questionnaire.

RESULTS

Descriptive Statistics

The study data was collected from Taiwan's regional hospitals and medical centers. A certain number of questionnaires (10 to each regional hospital and 15 to each medical center) were distributed to nursing department directors. We asked them to choose eligible respondents (nursing personnel who had experienced e-Learning) and send back the responses. Instructions indicated questionnaires should not be completed if the hospital had no nursing e-Learning system. This research collected 208 valid responses from 21 hospitals: 91(43.75%) from 9 medical centers and 117(56.25%) from 11 regional hospitals. There are 101 regional hospitals and medical centers in Taiwan, so the response rate was 20.79%.

More than half of participants were senior nursing personnel with 11 years of work experience. Responses indicate nursing personnel do not make use of e-Learning frequently; up to 75.00 % of them only use a system one to three times a week. In addition, results reveal that teaching-material searching and reading, online tests, and knowledge management (document management) are the most common functions in e-Learning systems. The descriptive statistics are illustrated in Table 2 and Table 3.

Table 2. Description of the participants

Background	Category	Number of responses (%)
Age	30 years old or younger	65(31.25%)
	31-40 years old	98(47.12%)
	41-50 years old	39(18.75%)
	51 years old or older	6(2.88%)
Title	Management Personnel	62(29.81%)
	General Personnel	146(70.19%)
Years of work experience in the current position	Less than 2 years	31(14.90%)
	3-5 years	71(34.13%)
	6-10 years	59(28.37%)
	11-15 years	25(12.02%)
	More than 16 years	22(10.58%)
Years of work experience in the	Less than 2 years	8(3.85%)

nursing field	3-5 years	32(15.38%)
	6-10 years	62(29.81%)
	11-15 years	56(26.92%)
	More than 16 years	50(24.04%)
Computer-use	1-3 years	20(9.62%)
	4-6 years	40(19.23%)
	7-9 years	49(23.56%)
	More than 10 years	99(47.60%)
Average use of e-Learning per week	1-3 times	156(75.00%)
	4-6 times	21(10.10%)
	7-9 times	6(2.88%)
	More than 10 times	25(12.02%)

Table 3. Description of e-Learning functions

Functions of nursing e-Learning	Number of responses (see *Note*)
Learning material searching and reading	162
Online test	137
Online discussion	66
Online Q & A	79
Statistical calculation	44
Knowledge management (document management)	118

Note: Each respondent may identify one or more e-Learning functions

Study Reliability and Validity

Before the data analysis stage could occur, raw data from the completed questionnaires was examined for reliability and validity. Careful literature reviews and an expert panel as well as pretesting ensured data validity. Cronbach's α was used to examine reliability. The α values of the variables ranging from 0.75 to 0.94 indicate the data is highly reliable (Hair, 1998).

Hypothesis Testing

In the Structural Equation Modeling (SEM) analysis, analyzing goodness of fit and examining explanatory power on the research model should be done first. Based upon arguments made by Bentler (1989), Bentler (1992), and Hu & Bentler (1999), five indicators were selected to conduct an overall evaluation on the goodness of fit. Table 4 presents the evaluation results. Analysis reveals the goodness of fit of the research model is acceptable.

Table 4. Goodness of Fit Analysis on the Research Model

Indicators	Values	References
χ^2 / d.f.	1.976	<5 (Bentler, 1989)
Goodness of Fit Index (GFI)	0.88	□0.9 (Bentler, 1989)
Root Mean Square Error of Residual Approximation (RMSEA)	0.069	□0.06(Hu & Bentler, 1999)
Normed Fit Index (NFI)	0.96	□0.9 (Bentler & Bonett, 1992)
Comparative Fit Index (CFI)	0.98	□0.95 (Bentler, 1989)

Figure 2, the path diagram of the structural model, shows that nursing personnel's "Intention to Use" is influenced only by "Information Quality." Nursing personnel's "User Satisfaction" with and the "Intention to Use" the nursing e-Learning system influences training effect and produces "Net Benefits." "User Satisfaction" influences "Intention to Use." Furthermore, the three exogenous variables "Service Quality," "Information Quality" and "Service Quality" of e-Learning systems retain their significant influence on "User Satisfaction," but only "Information Quality" influences "Intention to Use." Table 5 shows the results of hypothesis testing.

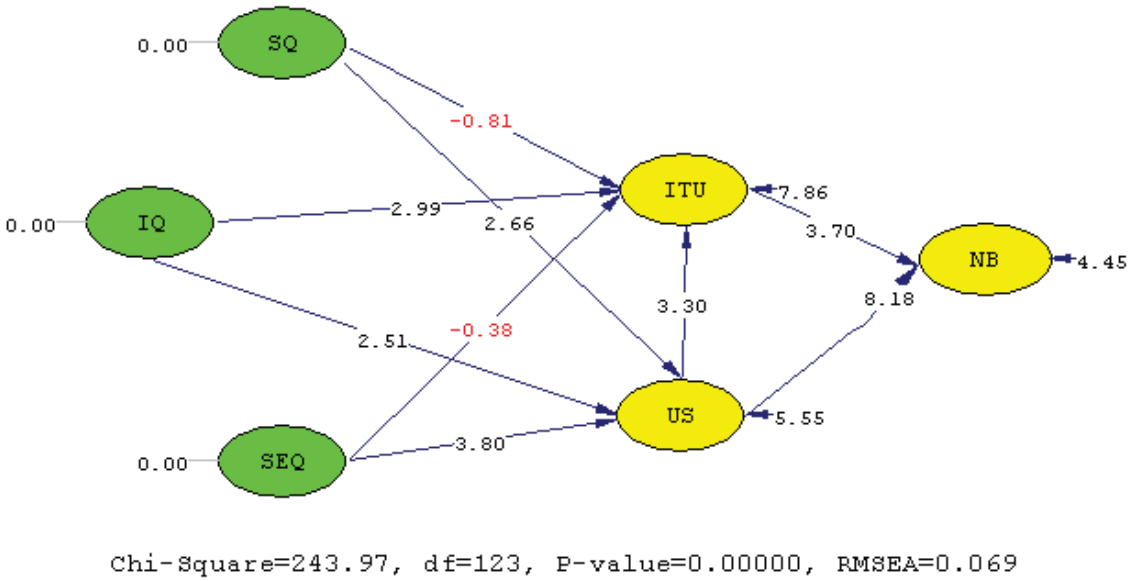

Figure 2. Structural Equation Modeling Result

Table 5. Results of Hypothesis Testing

Hypothesis	Result
H_1: In a nursing e-Learning system, "Service Quality" significantly influences "Intention to Use."	Not Supported
H_2: In a nursing e-Learning system, "Service Quality" significantly influences "User Satisfaction."	Supported
H_3: In a nursing e-Learning system, "Information Quality" significantly influences "Intention to Use."	Supported
H_4: In a nursing e-Learning system, "Information Quality" significantly influences "User Satisfaction."	Supported
H_5: In a nursing e-Learning system, "Service Quality" significantly influences "Intention to Use."	Not Supported
H_6: In a nursing e-Learning system, "Service Quality" significantly influences "User Satisfaction."	Supported
H_7: In a nursing e-Learning system, "User Satisfaction" significantly influences "Intention to Use."	Supported
H_8: In a nursing e-Learning system, "Intention to Use" significantly influences "Net Benefits."	Supported
H_9: In a nursing e-Learning system, "User Satisfaction" significantly influences "Net Benefits."	Supported

DISCUSSION

Quality factors Affecting Nurses' Satisfaction and Use Intention of e-Learning

Figure 2, the Structural Equation Modeling Results, indicates that all the three exogenous variables (System Quality, Information Quality, and Service Quality) significantly influence "User Satisfaction" with nursing e-Learning. Shachtman (2000) held that an online classroom is good in that it provides learners with an environment for self-learning, saves time and cost, and updates teaching materials with ease. After researching the use of e-Learning systems among registered nurses, Atack (2003) suggested that organizations carefully evaluate computer skills, computer access, and the learning environment when preparing for nursing web-based learning.

Kenny's focus group study (2002) on nursing students' online-learning use concluded that

computer confidence, flexibility, active learning and practicalities of teaching contribute to student frustration or satisfaction with online learning. The Kenny study also showed that technical support was vital for reducing anxiety when students experience problems. These study results imply that "System Quality," "Information Quality" and "Service Quality" (covering interface user-friendliness, function completeness, system stability, and technical support from external personnel), significantly influence "User Satisfaction" with a nursing e-Learning system. Due to the diversity of nursing personnel information literacy, information personnel and/or other technical support staff can greatly increase nursing personnel satisfaction if they express interest in users' success, help them solve problems, and offer real-time service when users of a nursing e-Learning system have trouble. This current study supports this conclusion.

By contrast, in this current study, the exogenous variables of "System Quality" and "Service Quality" did not show significant impact on "Intention to Use." A possible explanation is that nurses' learning and training concerns are for increasing knowledge and enhancing practical skills that an e-Learning system cannot accomplish alone. That is, these staff mainly regard e-Learning as a kind of auxiliary tool. Commonly, nurses are encouraged but not enforced to use e-Learning.

E-Learning and traditional classroom learning do not show significant differences in learning outcomes. For example, in one study, nurses passed nursing care skill tests regardless of the training method (e-Learning or traditional classroom programs) (Chang et al., 2008). Consequently, the content (information) a system provides is the principal influence on nurses' intention to use e-Learning rather than service or system qualities.

Nurses' Satisfaction and Intention Affects Net Benefits of e-Learning

DeLone & McLean (1992, 2003) pointed out that the personal degree of satisfaction with and use intention of the information system positively influenced the individual and the organization, that is, it had a significant relationship with "Net Benefits." Recent related studies revealed that nurses usually felt satisfied or very satisfied with e-Learning courses and showed a positive willingness to use e-Learning. This current study also confirmed that nurses' satisfaction and use intention for the e-Learning system had a significant impact on net learning benefits. The IS Success Model was validated as a powerful basis for exploring nursing e-Learning.

User satisfaction has the potential of being an important driving force to increase user's use intention for technology use (DeLone & McLean, 2003) or continued use (Bhattacherjee, 2001). This study of nursing e-Learning confirmed this relationship. Therefore, top-management should carefully consider how to promote e-Learning benefits and make a

continuous plan to satisfy nurses' needs for a hospital's long-term nursing education program. Of course, high quality service support and system maintenance are critical factors for making this aim come true.

CONCLUSION

Internet technology is real-time and flexible. It has gradually become one of the most important channels for spreading information and knowledge. However, the nature of the nursing field is so special that the influencing factors for introducing e-Learning systems and evaluating the degree of satisfaction differ from general information systems. In this study, only information quality of e-Learning systems displays a direct and significant relationship with nurses' use intentions. This result differs with studies probing the IS Success Model by scholars from the information management field. This difference implies service quality and system quality are not currently the first concerns in whether or not they will use e-Learning. One of the most plausible reasons for explanation is that nursing e-Learning is commonly regarded as a voluntary activity. As a result, the usage frequency of e-Learning is low for heavy-load nurses. This study also reflects the same phenomenon.

In the nursing learning context, some studies suggest that integrating e-learning and traditional face-to-face instruction is useful for enhancing healthcare knowledge, reducing the lecturing time and cost (Sung et al., 2008). An integrated curriculum design could raise nursing personnel's intention to use a nursing e-Learning system and the following benefits be further boosted. In this way, new verification may be able to support the model proposed by DeLone & McLean (2003).

Nursing e-Learning is still in a beginning stage with many uncertain factors and issues to be clarified, investigated and overcome. Investigating these factors and issues would contribute to the comprehensiveness and amplitude of the IS Success Model in nursing e-learning use. Other constructs and indicators, such as information culture (Curry & Moore, 2003) as well as other theoretical models, such as the Technology Acceptance Model (Davis, 1989; Venkatesh et al., 2003), Technology-Task Fit (Goodhue, 1995) and Innovation Diffusion Theory (Rogers, 2003) could modify and enhance this research framework. Such extended or integrated approaches may provide additional insights to understanding nursing e-Learning use. Academic and practical researchers need ongoing experiencing and advance exploring in nursing e- Learning in order to solidify the framework with broader explanations.

Finally, we acknowledge the following limitations. The research subjects were medium- and large-scale medical institutions, and small-scale hospitals, which meant a great number of institutions were excluded. This could have affected the representativeness of this study. The major reason, however, is that only a few small-scale hospitals (Hwang et al., 2005) have

adopted e-Learning systems. In addition, the questionnaire response rate from hospitals was just 20.79%, which cannot represent the whole population.

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THE FAST STRATEGY AND DYNAMIC DECISIONS IN ENERGY INDUSTRY

Tomi Mäkipelto, University of Vaasa, Finland
tomi.makipelto@student.uwasa.fi
Kongkiti Phusavat, Kasetsart University, Thailand
fengkkp@ku.ac.th

ABSTRACT

In the energy industry the global and local political decisions are growing renewable and CO_2 free energy production methods and carbon capture technology competitiveness. From the sustainable development and readiness of technology point of views wind power is one of the most economical ways to produce energy.

The main goal of the research was to modify the agility strategy model in energy industry. The sub goal was to evaluate and analyze decision making process in the energy industry and competitive priorities of the investment especially in the wind power industry. The sub goal of the research was also to test applicability of the results in global contexts. A part of the research analyzes USA's and Finland's energy industries' decision making processes and competitive priority similarities. This work links to the existing scientific research.

The corresponding researcher Tomi Mäkipelto is a Managing Director in a company which main focus is to invest in wind power in Finland and also in other Nordic countries using the newest technology. The used research methodologies were an action analytical and a constructive case research. The used main methods were a Fast Strategy and Sense and Response. Empirical data was collected by using researcher's observations, including informal discussions and by using formal questionnaires. The validity of the results was tested by different statistical parameters and brainstorming. The results showed a high validity. Construction was tested by a weak market test in which the result was positive.

Keywords: dynamic decision, fast strategy, sense and response, energy industry, wind energy

INTRODUCTION

Climate change is due to the growth in GHG emissions which is a consequence of human actions. The gases hold the sun's thermal radiation on the surface of the earth and thereby rise the average temperature on earth. The rise in temperature also affects on the cycle of the energy and substance on earth. The average temperature on earth also changes naturally but the speed of the current change is exceptional.

According to World Health Organization's Climate change and human health -risks and responses report (17) our increasing understanding of climate change is transforming how we view the boundaries and determinants of human health. While our personal health may seem to relate mostly to prudent behaviour, heredity, occupation, local environmental exposures, and health-care access, sustained population health requires the life-supporting "services" of the biosphere. Populations of all animal species depend on supplies of food and water, freedom from excess infectious disease, and the physical safety and comfort conferred by

climatic stability. The world's climate system is fundamental to this life-support. In Figure 1 it can be seen how Earth's average surface temperature has been variating over the past 20 000 years.

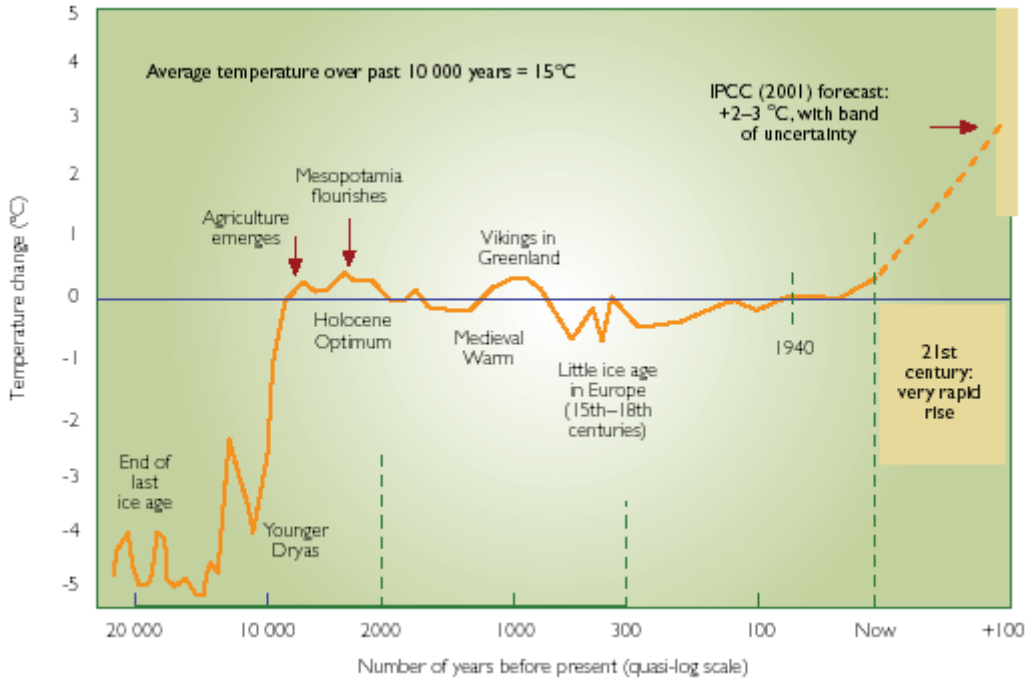

Figure 1. Variations in Earth's average surface temperature, over the past 20 000 years. (17)

Respectively human nature needs energy (electric and heat energy) in order to produce the necessary life supporting "services". According to IPCC's (8) professionals connection between the global warming and the greenhouse gas (GHG) emissions are obvious. The largest growth in GHG emissions in the last decades has come from energy industry and transport. On the first hand, those two sectors are the biggest GHG emission producers (example CO_2) and, on the other hand, they are the key players to put a damper on the growth of GHG emission. Under these circumstances the energy production plants will hold the key position in controlling the climate change and thereby its consequences.

Controlling the climate change is a global challenge. The fact that the problem is global but the solutions are local complicates rising to the challenge. Local solutions have their own consequences and thereby solving the global problem requires sacrifices at local level. Often the benefits of these sacrifices are less concrete than the disadvantages or consequences are. As a concrete example of this is wind power. From sustainable development and readiness of technology point of views wind power is one of the economical ways to produce energy. From global point of view it is possible to produce energy in a sustainable way but locally it is not that simple: there are natural resources in every area and these resources can be disturbed from building or from the action of wind power. Figure 2 illustrates the complicated relation between the global problem and the single solutions to that problem.

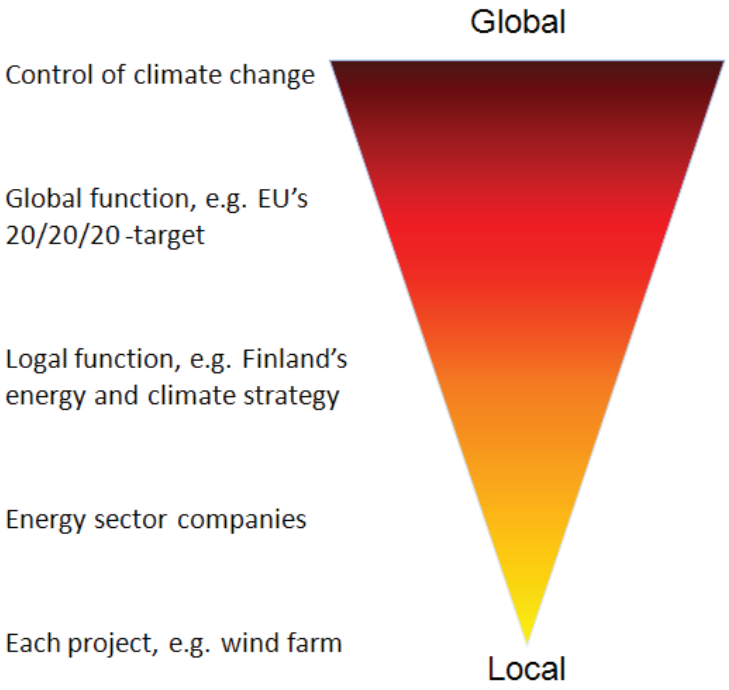

Figure 2. The complicated relation between climate change and the ways to prevent it.

It is crucial in energy field to have local acceptability for the projects. In the background of the acceptability there are the actors' determined strategic choices to focus on such production forms that can meet the needs of the society for decades. Large, renewable energy production investments will carry on in the future in order preventing the climate change. During 2005-2007 investments in new renewable capacity has nearly doubled measured in money (18).

In Europe the opening of the markets has led to a situation where more and more energy based companies are aspiring a new position in the industry or in the value chain. There has been seen an integration between different industry fields. Due to this new kind of actors have arisen alongside with traditional state/municipal owned corporations (10). The importance of this matter is emphasized by European Union's an agreement on the goals of climate and energy policies. European Union has agreed to cut down GHG emissions by 20 per cent by 2020 from the level of 1990. At the same time European Union has committed to raise the share of renewable energy sources of final energy consumption from 8.5 per cent (in 2005) to 20 per cent by 2020. (2)

When investigating what factors have the largest impact on the life cycle profits of large scale energy production investment in Finland a clear connection was found: economical factors and political and legislative factors are the most important factors when deciding on energy production investments (13). Figure 3 shows the relative importance of the factors affecting on investment decisions.

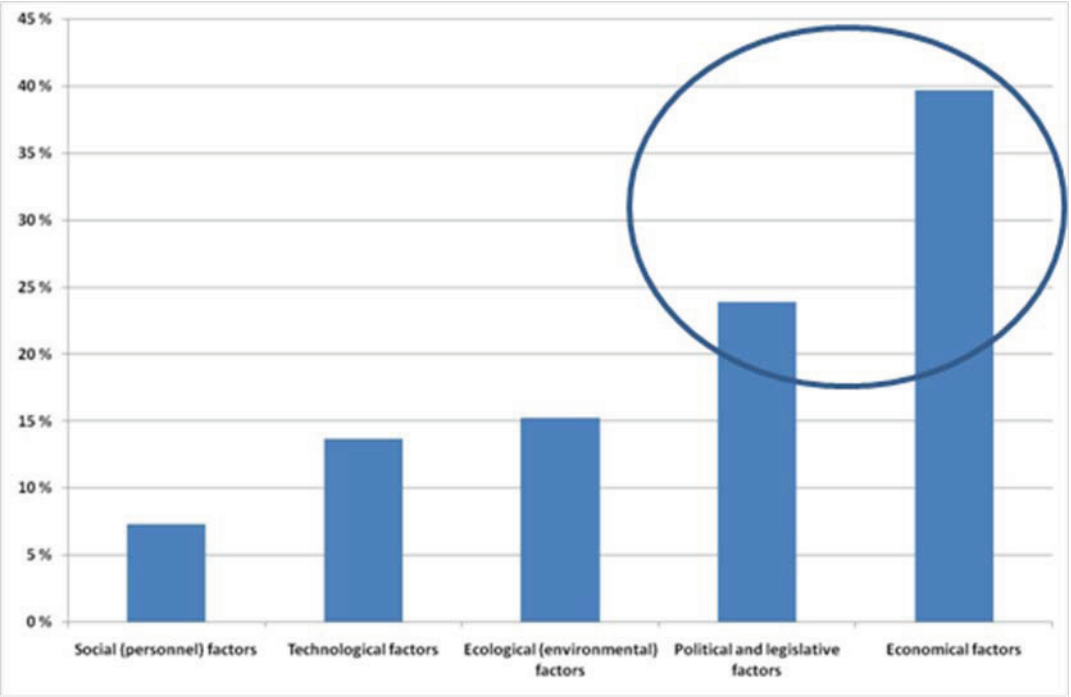

Figure 3. Factors have the largest impact on the life cycle profits of large scale energy production investment in Finland and their importance relative to each other.

According to figure 3 economical factors and political and legislative factors form over 64 per cent of the whole framework, in which the investment is based on. The factors in question are dependent on each other because political and legislative factors form wholeness which determines the sufficiency of economical factors. Typically the investments in energy field have to have a political and legislative framework so that the economical position can be secured with a relatively low profitability. There are even 20 years long repayment periods in energy industry.

The purpose of the research

The meaning of this research is to focus on the investments made in the energy industry and on analyzing the factors affecting those investments. The main goal of the research was to modify the fast strategy model in energy industry. The sub goal was to evaluate and analyze the energy industry decision making process and competitive priorities of the investment especially in the wind power industry. The sub goal of the research was also to test applicability the results in global contexts. A part of the research analyzes USA's and Finland's energy industries' decision making processes and competitive priority similarities. The suppliers can utilize these findings when constructing and modifying their strategies to be more sensitive.

Research's empirical data was collected by using the researcher’s observations including informal discussions and by using formal questionnaires. The researcher's earlier research results have been utilized in this study. Whit this research it is meant to go deeper on the earlier findings and expand the knowledge they bring.

In this research an innovative and theoretically justified solution has been created to answer a practical problem. The results have been tested with a weak market test. The approach is constructive (9).

The research method is an action research, in which the research combines existing theoretical knowledge and after that empirical results are compared to the theory. The external and internal validity of the dynamic decision making model developed in the research has been tested with a "weak" market test including interviews, brainstorming for the specialists in the industry.

The energy industry is undergoing a changing process. Due to this process, investments in production processes have significantly reduced during the last decade. Uncertainty has grown with the capital intensiveness, long term energy production modes. Circumstances described above support the need for this research among the decision makers.

RESEARCH STRATEGY AND THEORETICAL FRAMAWORK

The meaning of this research is to create a model that takes into account the development of investments in different periods of time. There are different factors in the background of the investments depending on whether it is a decision making situation, a situation at the end of investment's life cycle or a situation somewhere in between. Figure 4 describes a situation (big cube) where investor makes the decision in time n and it is attached to certain framework boundary conditions (small cube). In the energy industry this means for example a decision to build a certain type of power plant (nuclear power plant, wind farm, coal power plant, etc.). Researcher's earlier research focuses on this topic (see e.g. 11, 12 and 13).

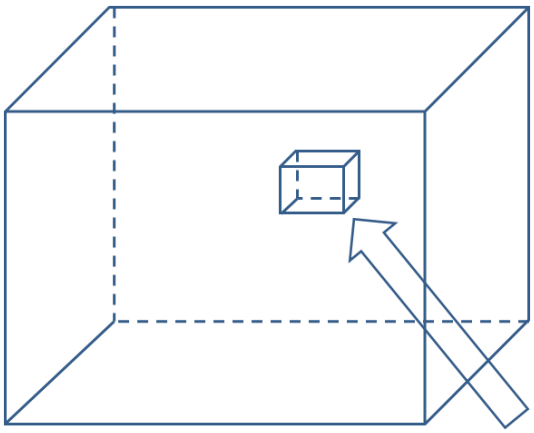

Figure 4. Operational framework at a decision making moment of the investment.

As the actor attaches itself to certain technical boundary conditions the future changes of the framework have to be taken into account especially carefully. The companies have to be able to adjust themselves particularly into political and legislative frameworks, so that the economical requirements can be guaranteed. Wittmann (16) demonstrates how bounded rational decision models can be standardized and parameterized by socio-economic data. He focuses on private energy technology investment decisions and shows how different

representative agents can be constructed using search rules, analysis tools and decision strategies.

The operation field of energy industry can be described in several alternative ways. Bruckner et al. (1) present two modelling strategies:

- high resolution modeling, is designed to capture the technical interactions and supervisory control practices and
- entity oriented modeling, builds on high resolution modeling by adding agents and markets in order to capture the commercial interactions which arise when multiple decision-makers are present.

These alternative descriptions are meant to illustrate how different factors in the industry connect to each other.

Respectively when examining only one investment it can be seen in Figure 5 that the options diminish during different stages in the life cycle of the production mode. The meaning of this research is to create a model for strategic leadership for different stages of the investment's life cycle. In creating the model earlier research results and theoretical frameworks are combined.

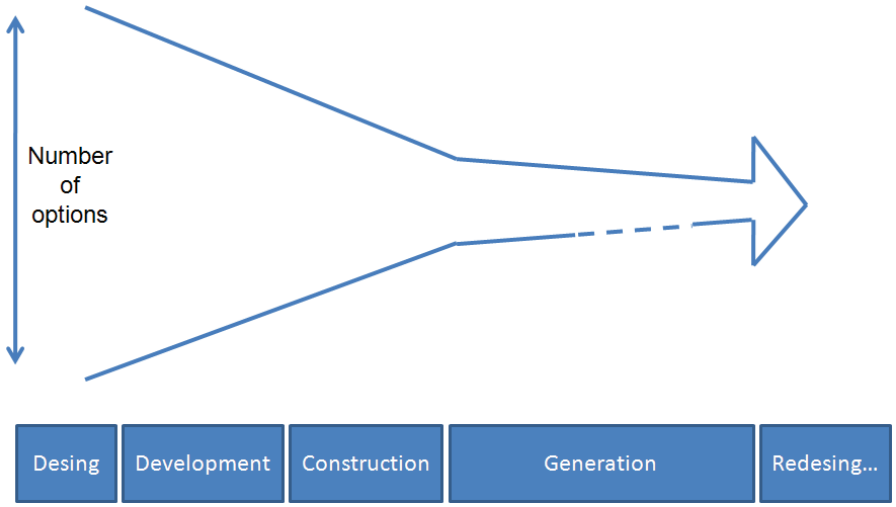

Figure 5. The number of options in different stages of the investment's life cycle.

The research strategy has been divided into two stages. At the first stage the model is created and at the second stage the applicability of the model is tested in an preliminary international comparison in the USA. The theoretical framework mainly consists of researcher's earlier research results and Mikko Kosonen's and Yves Doz's Fast Strategies and Sense and Responsd methods.

According to Mikko Kosonen's and Yves Doz's (3, 4 and 5), the companies should form their strategies to be more flexible and the strategic decisions should be agile. It should be possible to reform the companies' strategies continuously: weekly, daily or even hourly. The main components of strategic agility are strategic sensitivity, collective commitment and resource fluidity. According to Nieminen and Takala (14) agility is company's ability to act and fight in the dynamic state of continuous changes.

The meaning of Strategic Sensitivity is both the sharpness of perception and the intensity of awareness and attention. Resource Fluidity means the internal capability to reconfigure business systems and redeploy resources rapidly. Collective Commitment means the ability of the top team to make bold decisions fast.

Respectively according to Stephan H. Haeckel (6) companies' business can be led in two alternative ways: "make and sell" -principle or "sense and response" -principle. Make and sell principle forms an internal, closed system, in which signals from outside are not followed systematically. Sense and response principle utilizes internal feedback and external signals. Figure 6 describes the basic principles of both systems.

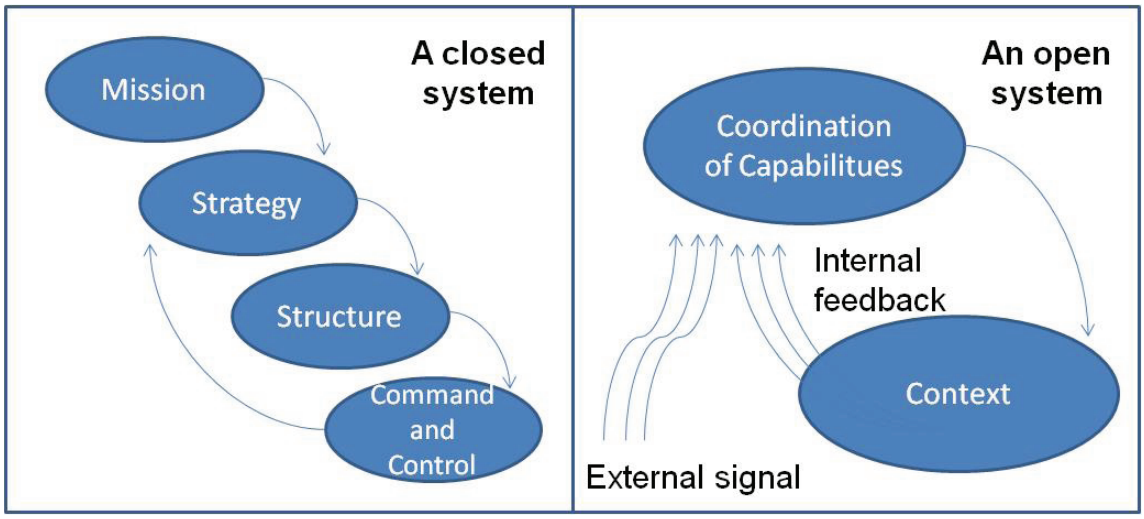

Figure 6. Two alternative strategic ways to lead a company (6).

According to sense and response -principle companies look for influences from outside the company and act on them. These two principles can also be described as open and closed system. The hierarchy of the closed system also separates these two systems.

Accorging to Doz and Kosonen (4) a fourfold table has been created. The meaning of the table is to specify the relation between strategic agility and corporate entrepreneurship, strategic planing and operational excellence. Respectively Heackel (6) separated two different goals: goal to become an adaptive enterprise and goal to become efficient enterprise.

Strategic leadership can be interpreted as the whole activity of the company or as a strategic leading of certain part of the whole. Figure 7 shows how strategic agility is placed with speed of change, nature of change and political and legislative framework.

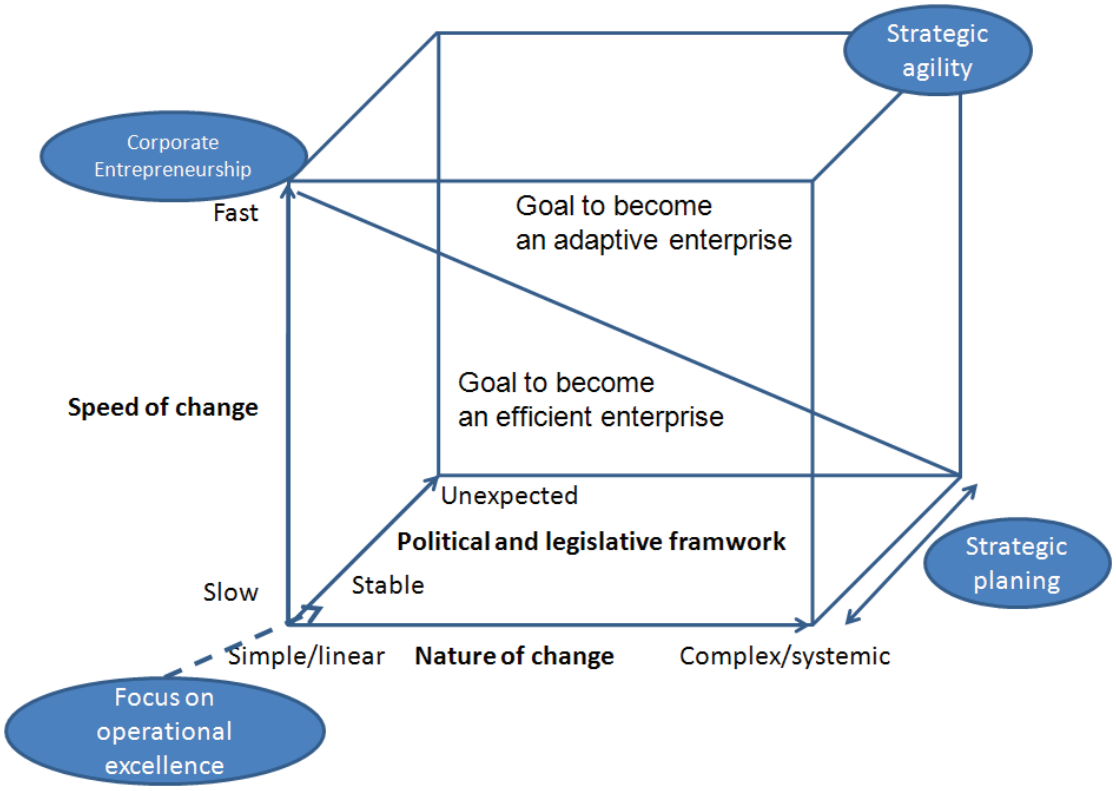

Figure 7. Strategic agility and response in relation to changing factors in energy industry (adapted Kosonen and Doz (4) and Heackel (6)).

Examining the same thing from sense and response point of view it can be seen that Figure 7 points out how companies' goals are placed in relation to operating area. The framework shows that when the operating challenges grow the operation model should be guided to be more strategically agility.

According to Hamel, Doz and Prahalad (7) common factors, which affect on strategic sensitivity and noticing external signals, arise when viewing cooperation between different companies and competitors. These factors are:

- collaboration is competition in a different form,
- harmony is not the most important measure of success,
- cooperation has limits. Companies must defend against competitive compromise and
- leaning from partners is paramount.

Respectively C.K. Prahalad and M.S. Krishnan (15) think that companies have to include clients individually in the process of creating business and that companies have to be able to continuously gather up the best resources and knowledge in the world.

Cooperating and learning by that is part of the communication process between actors, it is also part of viewing strategic options, searching new competitive advantages and adapting to the political and legislative framework.

RESULTS AND ANALYSIS

A model that combines existing strategic models has been created as a result of this research. The model also completes the existing knowledge by taking into account the empirical facts from energy industry's experts. As can be seen in Figure 3 the most important factors are economical and political and legislative conditions when making investment decisions in energy industry. These factors are attached to each other. The more unsure the political and legislative sustainability is the larger is the economical yield expectation and vice versa. The factors are not necessarily directly proportional in every occasion and within every production mode. Figure 8 illustrates the situation.

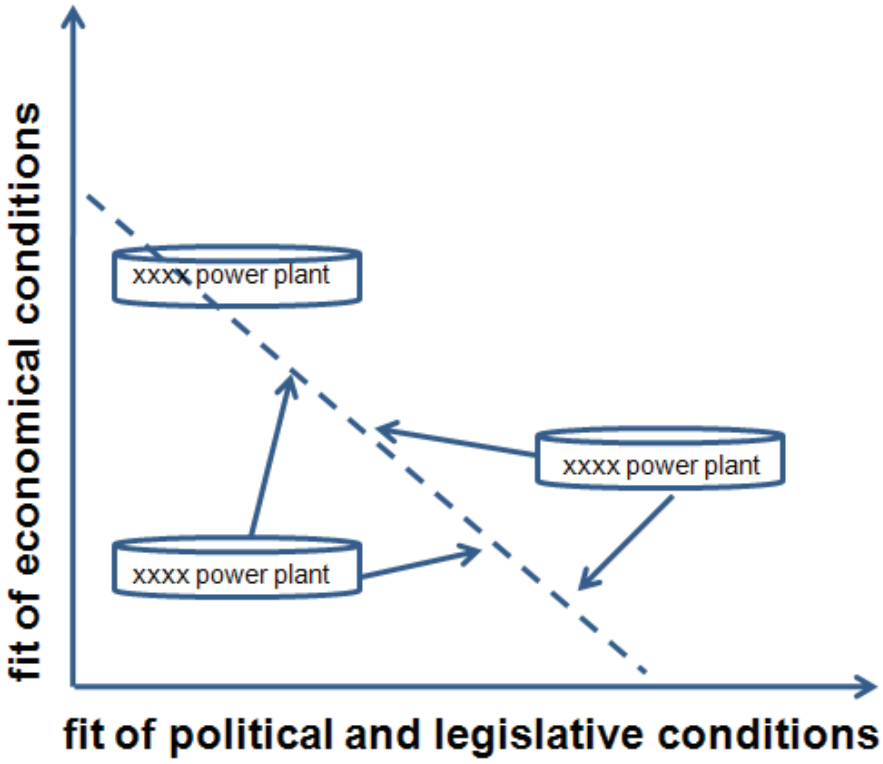

Figure 8. The paths leading to energy power plant investment decision.

It can be seen in Figure 8 that depending on the energy production mode there are different profit expectations in different political and legislative frameworks. Perceiving the framework in question requires strategic leading, continuous observing of business environment and guiding the business operations to the desired course. Strategic leading is meant to find the beneficial timeframes when the desired conditions for investments exist. A beneficial investment situation is a wholeness which requires simultaneous support from every interest group around the project. This is affected by the financiers' positions, technological possibilities, political atmosphere, availability of workforce, demand for the product and its market price etc. (see e.g. 16).

Combining the results of this research with the existing theoretical framework a model is created. The meaning of this model is to map the state of the surrounding framework and conditions as Figure 8 shows. Based on Kosononen & Doz (4); Heackel (6); Hamel, Doz and Prahalad (7); C.K. Prahalad and M.S. Krishnan (15) earlier researches a process chart has

been created. The functionality of this process chart has been tested by interviewing the experts in the energy industry. In Figure 9 strategic agility, sense and response -principle are combined so that unique competitive advantage is created by utilizing the added value gained by strategic alliances.

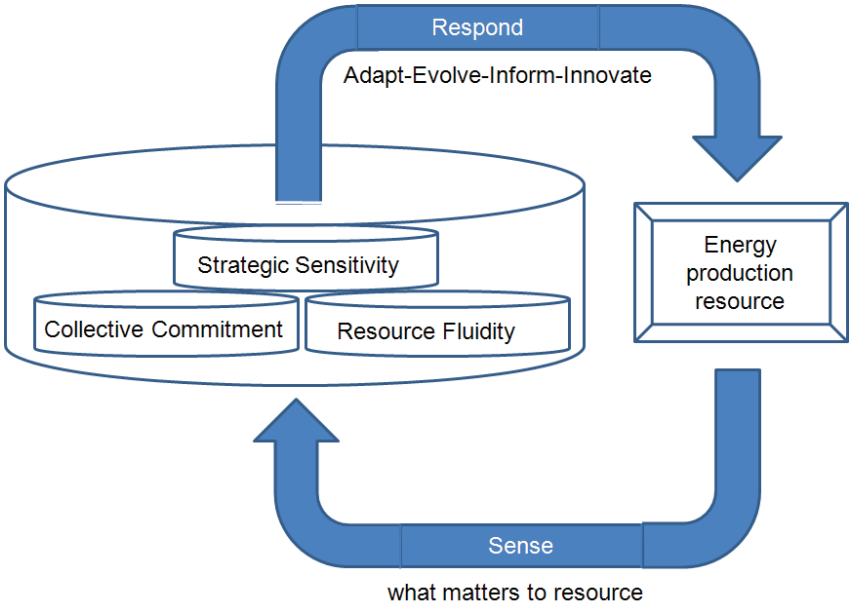

Figure 9. Dynamic strategy model for energy sector.

Utilizing the best talents is extremely important in companies' strategies. This is represented on the left side of Figure 9 as its own unity. Companies' business operations have to be able to adapt on the influences coming from outside. By utilizing these influences and possibilities companies can achieve competitive advantage relative to other actors in the industry if they succeed in strategic leadership.

When reviewing especially the content of energy production recourses it can be seen that according to the findings of the research three connected factors emerge in the investment decision making process. These factors are:

- minimize investment and maintenance costs,
- maximize performance and reliability of investment and
- optimize life span of investment (12).

These factors can be put into a time span which tells the size of influencing possibilities of strategic agility in relation to time. In Figure 10 it is presupposed that origin is in time n-1 and first circle is at the moment of the investment decision n.

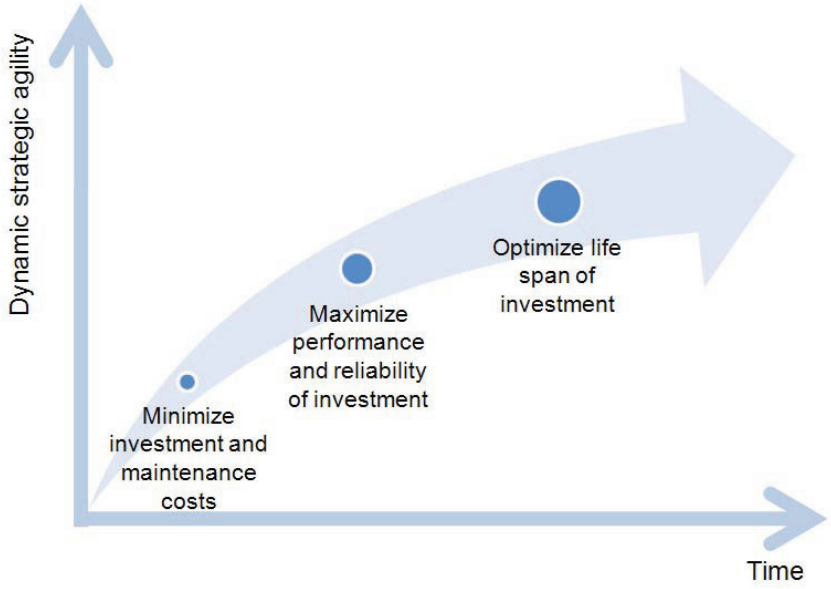

Figure 10. Relation between dynamic strategic agility, time and set goals.

Through dynamic strategic agility, as Figure 10 shows, the main goals that investors hold important when investing in large scale, capital intensive energy production plants. Importance of dynamic strategic agility grows when going further in the timeline because the investment situation has changed into maintenance of the production plant and actions required by the outside framework.

Efficiency advantages throughout the whole life span of the investment can be achieved by acting strategically consistent. Operating in the energy industry differs from many other industries because of its capital intensiveness and political influences on the business. Investment decision making processes are characterised by long repayment periods which differ from many other industries fields.

TEST OF APPLICABILITY AND EVALUATION OF RESULTS

The applicability of the research was tested with an international literature review and comparison. In international comparison the method was interviews and on based on the interviews was found out in the large scale what are the most important framework drivers when company's make investment decisions in a large scale energy production and in the small scale what are the most important factors that company's prefer when they make investment decisions in the energy production (e.g. wind power plant, coal power plant, nuclear power plant,..).

The research results were also tested by a weak market test with separate interviews. On the grounds of the interviews it could be seen that the factors emphasized by the model were the same that the experts hold the most important. When making international comparison the fact that actors in the energy industry follow the local law has to be taken into consideration. The framework in energy industry often differs significantly between different countries (cf. the acceptance of nuclear power or support for renewable energy production).
According to the interviews, the experts in the USA hold the following framework drivers as the most important ones when companies make investment decisions in a large scale energy

production are suitable economical conditions and good technological solution. Respectively the most important factors that they prefer when they make investment decisions in the energy production are good performance and reliability of investment and low investment and maintenance costs.

The research results show adequate internal and external validity. On the grounds of the preliminary findings it can be seen that the same factors arise both in the USA and in Finland. The findings can be applied generally on the grounds of the international comparison made during the research process, although the comparison can not be held as watertight.

The reliability of the research has been raised by interviewing some of the specialists who answered a formal questionnaire. The specialists' opinions did not change when they answered the main questionnaire and when they answered the additional questions of the interviews. The specialists' opinions are also the same after brainstorming sessions. If all the specialists were personally interviewed, the results would have been more reliable. If more specialists were interviewed in the case companies and if the interviews were done several times, even higher validity of the results would have been achieved so that the results could be compared better to each other.

The research results can be widened, deepened and tested by separate ways. In the following researches the international interface should be expanded and tested by alternative ways. The results can also be deepened by testing the model in some other industry such as telecommunication business.

CONCLUSION

The main goal of the research was to modify the agility strategy model in energy industry. The sub goal was to evaluate and analyze the energy industry decision making process and competitive priorities of the investment especially in wind power. Another sub goal of the research was also to test applicability the results in global contexts. The energy industry is exceptional because of not only the limitations set by ownership and cost structure, but also limitations set by the official supervision and special technical features.

The research findings give the investors a possibility to reform their strategies to be more sensitiveness way and the same time make own fast & dynamic decision model. The theoretical part of the research consisted of the different strategic methods. This work links to the existing scientific research.

The process will help the investors to understand energy sectors' global context and new modified strategy model in energy sector. The results showed that the model of the fast strategy and dynamic decisions in energy industry are created and test both from the local and global contexts.

The results of this research are a contribution to science because they fulfill the goal that was set for this research and its starting point lies on previous literature on the matter. This work links also to the existing scientific research. In the future, it is obvious that certain changes are taking place in the industry and, therefore, the dynamic multi-criteria decision making process will help decision makers to modify their strategies to be more agility.

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ENVIRONMENTAL MANAGEMENT SYSTEM IN EUROPEAN UNION (EU): COMPARATIVE ANALYSIS OF SOME CASE STUDIES

Giovanni Lagioia, University of Bari, Italy
g.lagioia@dgm.uniba.it
Vesselina Dimitrova, University of Economics Varna, Bulgaria
vesselina.dimitrova@mail.bg
Teodoro Gallucci, University of Bari, Italy
teodoro.gallucci@gmail.com

ABSTRACT

The aim of this paper is to verify whether the voluntary environmental policy tools introduced in the last years in Europe, as EMAS and Ecolabel, have achieved the pre-fixed results both from environmental and economic points of view. This paper presents the findings of different case studies carried out in tourism sector and in the power plant sites for energy production in Italy . During the years, limited review works have been carried out in the EU in order to confirm or to reject the performance and the efficiency of the adoption of EMAS or Eco-label certifications. This research enriches the empirical usefulness of the above-cited environmental tools.

Keywords: Environmental management system (EMS), Ecolabel, Eco-management and audit scheme (EMAS), Tourism sector, Energy production.

INTRODUCTION

Nowadays sustainability issue in production activities is a discussed subject, because it represents one of the main environmental business concerns. The lack of clear environmental policy and the inadequacy of the socio-economic system are characterizing these phenomena and are outlining the importance to redesign the manufacturing system in the context of the political community aware that, more sustainable economy requires management changes in its economic activities. The increased awareness for environmental protection and its relative important impacts associated with products or services has driven the International Community to develop strategies and methodologies in order to monitor and control both technological and environmental concerns. For this reason the EU has been fostering, mainly the SMEs, in technical and environmental improvements, since this is considered as a vital strategy towards sustainable development. In order to make businesses and their environmental improvements more effective, the EU has developed some voluntary environmental tools as the ecomanagement and audit scheme (EMAS) as well as the Eco-label regulation. The first one, launched in 1993 and revised in 2001 with EMAS II, at present is going under a new revision-the EMAS III. It represents a system for companies and organizations wishing to undertake, assess and improve their environmental performance. The second tool, launched in 1992 and revised in 2000, is a label that rewards the best products and services with a lower environmental impact in their lifecycle than similar or substitute products that has validity for Europe. After the coming of EMAS and Eco-label, the number of adopting organizations and companies is growing. In both cases, the objective was to drive through the business excellence. In this decade, one more significant question stands out: whether this voluntary environmental policy has achieved the pre-fixed results suggested by the EU? In fact, another important consideration is the contemporary market entrance of the International Organization for Standardization (ISO) 14 001 standard which,

with its global significance, is concerning more the export outside the EU companies. Even if EMAS and ISO 14001 share the same objective, they have started being competitors and in the last years ISO 14000 is emerging as the winner in the battle for supremacy among environmental management standards in Europe as showed in Table 1.

Table 1: Trend of EMAS and ISO certification in Europe

	2000	2007
EMAS (registered sites and organization)	3,325	37,200
	7,140	65,097

Source: (12-13)

In Italy we also have recorded the same trend. At the end of 2007 the ISO certifications released in Italy have totaled 11,717 whereas EMAS certification for the sites were 1,031 and for organizations 740.

For this reason the European Union has decided to revise EMAS to EMAS II, shifting from "site" to "any organization" as company, corporation, or authority. In this way the ISO 14001 became the engine for the EMS requested by EMAS II. As a result, the compatibility between ISO and EMAS was achieved rapidly and nowadays almost all the EMAS companies in Europe are ISO 14001 certified.

However there are some differences between the two standards of certification, ISO 14001 and EMAS Regulation, as Table 2 shows:

Table 2: Differences between ISO 14001 and EMAS

	ISO 14001	EMAS
Area of applicability	Worldwide	Certification procedures (2-tier) by an accredited body	EU	Review of the environmental management system and validation of the environmental declaration by an approved environmental verifier
Verification via		
Public information	Within the scope of the organizational communication procedures	n.a	Obligatory via publication of the validated environmental declaration
Registration			Entry in the German and European Site Register by the Chamber of Industry and Commerce or the Chamber of Handicrafts
Employees involvement	n.a		Active involvement of employees and their representatives
Logo	no		yes

Source: Personal elaboration of the authors

The main difference is the normative aspect. The ISO 14001 should be governed by technical standards produced by ISO that is a private non-governmental organization, while the system of environmental management and audit scheme (EMAS) and Eco-labeling schemes for products as well, are both governed by two regulations, comply with Regulation (EC) No 761 of 19 March 2001 and Regulation (EC) No 1980 of July 17 2000. Furthermore, the ISO that the latter has (e.g. environmental statement, legislative compliance, public aspects etc.). A little different are the considerations for Eco-label.

The EU Eco-label has the aim to encourage greener products and services. In this case also the participation is voluntary and for its adoption ecological criteria (37 mandatory and 47 optional) for different product groups (in total 26 groups), such as paper products, textiles, detergents, paints refrigerators, dishwashers or tourism, have been established. The logo is a flower and among the 47 optional criteria are necessary at least16.5 points from 75.7 points in total. The most significant mandatory criteria to satisfy are: electricity from renewable sources, energy efficiency from electrical equipment, water saving taps and showers and waste separation. Most of the environmental measures in setting the Ecolabel require time and efforts but offer many advantages. For example the EU Green light program has showed that the reducing of natural resources like water and energy means cutting costs and then achieving competitiveness. Italy is a leader in Europe in the Ecolabel award scheme as witnessed from following figures: for the period 1998 - 2007 145 Ecolabel licenses in 13 different groups have been released of which 58 only in the tourism sector.

Objective

The goal of this study is twofold. *Firstly*, to record environmental performance of EMAS and Eco-label management practices among the companies and productive sites. *Secondly*, to scrutinize and verify whether the current adoption of the criteria for EMAS and Eco-label is supplying opportunities for better management and environmental benefits.

This paper presents the findings of different studies carried out in tourism sector and in the power plant sites for energy production in Italy. During the years limited review works have been carried out in the EU in order to confirm or to reject the performance and the efficiency of the adoption of EMAS or Eco-label certifications. This research enriches the empirical usefulness of the above-cited environmental tools.
The paper presents the methodology of the research and after is structured as follows: paragraph 2 gives the main results of the investigation in the sector of power generation, paragraph 3 shows the main results of the investigation in the tourism sector whereas the paragraph conclusion summarizes the main findings of this investigation.

Methodology

For scrutinizing the performance of EMAS power plants a review study of their environmental reports has been carried out. Furthermore, in order to gather information, interviews with managers, visits to administrative individuals and environmental verifiers (AEVs) have been conducted. This investigation includes all monitoring mechanisms which are implemented in the accounting systems of companies. The analysis of energy, water, and waste flows and their external effects has allowed to make an accurate picture of their environmental performance.

For investigating the Ecolabel in the tourism sector a questionnaire was sent to each of 58 hotels in Italy and than the authors have conducted interviews in order to evaluate its efficiency from economic and environmental points of view. We also have recorded their opinion about some possible implementations of new management strategies or technical innovations.

FIRST CASE STUDY ON EMAS IN THERMOELECTRIC POWER PLANT

Thermoelectric power plants produce electricity (output) through the transformation of the chemical energy of fossil fuels (input), e.g. fuel oil, natural gas, coal, into thermal energy and than into steam. The output of thermal energy generated, measured by calorific value, depends on the type of fuel used in the process. A high calorific value implies higher thermal energy.

In details, a thermoelectric power plant is an installation in which the thermal energy is converted, through a thermal cycle, into mechanical energy and then, through the alternator, into electricity. The fuel burned in the boiler produces thermal energy that converts water into steam. The latter is strongly overheated, and acting on the turbine vanes transforms the potential energy of the steam into mechanical energy. In a conventional thermal plant only less than 40% of thermal energy released by combustion in the boiler is converted into electricity. The remaining over 60% is dissipated in other conversion of energy (from thermal to chemical, thermal from mechanical to electrical to mechanical) and it is released into environment as poor thermal energy, and it isn't capable of being exploited as input for further energy processes. The electricity output is carried by means of long distance power line to the transformer stations where other processors make it available to the demands of *natural gas power plants, internal burning power plants, natural gas combined cycle power plants, coal power plants, cogeneration (electric energy and heat) power plants*. From the data in 2008, Italy has an energy demand equal to about 340,000 GWh, roughly 300,000 GWh are produced in Italy and more than 40,000 GWh (over 10%) are imported. The power-plants totaled 76 (have been excluded the hydroelectric and the biomass plants) of which 10 are repowering or modifications of existing plants. The biggest operator is ENEL with 58 power-plants of which 7 have obtained the EMAS certification whereas another 4 are proceeding for the accreditation. The second operator is Edison that has 7 power-plants with EMAS and then ENIPOWER with 3 power-plants with EMAS.

In this paragraph the authors have analyzed and investigated the environmental reports of both ENEL, ENIPOWER and EDIPOWER for two types of thermoelectric power-plants: a) power-plant fed by coal; b) power-plant fed by natural gas. In the both cases the results have been arranged through an input/output analysis for being compared with power-plants without EMAS certification, in order to verify whether environmental improvements have been recorded.

Results

For focusing the specific aim of the study the figures, coming up from the environmental reports of each EMAS power-plant, have been integrated with phone interviewed both with EMAS responsible and with private environmental verifiers. The crucial questions related to our investigation were: a) the motivation for the EMAS; b) costs for introducing EMAS; c) the environmental indicators after EMAS. The results are the following:

a) The sector of power generation has a large amount of environmental burdens. Furthermore, in the last decades the public opinion has started an impressive campaign of information about the negative spillovers coming from the emissions of power plants on the environment (as emissions into air, soils and so on). Differently by the other sectors, the power generation sector is more subject to critiques both from public opinion and media about the consumption of natural resources or different hazardous emissions and wastes. For offsetting these negative emissions, more and more restrictive rules have come into force in the last years both at domestic and international levels. These new standards are pushing massive economic investments. For this reason the interviewed expertise claimed that the main reason in starting the EMAS procedure was the both increasing pressure of the stakeholders and the periodically economic investments already planned for upgrading equipment which could have allowed easily to reach environmental standards requested by EMAS. From this last consideration emerges that the most important incentive on EMAS participation relies on the influence of public regulator always more and more interested in the environmental issues. This is different as is recorded for other sectors in which the main motivation is to improve the competitiveness. Anyway the interviewed have agreed with the findings, recently published, which indicate that EMAS leads to internal benefits, as well as it allows the identification of many processes bottleneck that are normally hidden behind the production routine.

b) The interviewed representatives state that the major costs regarding EMAS are, in general, linked with machinery upgrading and new environmental protection system installation. However it is important to underline that is not possible to specify the budget for installing EMAS in each power plant since the costs are aggregated in the “allocation” investments. This means that each operator (as ENEL, EDISON, EDIPOWER and so on) accounts, normally, in the triennial budget the environmental expenditures including the EMAS certifications. For this reason becomes difficult to extrapolate the expenditures related only to EMAS or similar. It worths to be mentioned, however, that the companies have introduced, since the last 4- 5 years, the allocation “environmental accounting system” which, according to the typology of the expenditures, allows to evaluate the total environmental investments. On this regard have being taken agreements for future research activity with the aim to extrapolate the specific allocation “certification costs”. Nowadays it is possible to estimate only the average costs for the external verifier and the registration fees which amount roughly to _50,000.

c) For verifying the effectiveness of EMAS from environmental point of view, firstly the data coming from the environmental reports have been disaggregated and successively reordered by typology according to the power technology generation and fuel typology (1-11, 14-16). In the last step an input output analysis in physical units has been made comparing figures with EMAS power plant and figures without EMAS as shows Table 3.

Table 3 – Environmental performances of power plants

INPUTS	Units	Coal (>2,500 MW)	Natural Gas (>2,500 MW)	With EMAS Oil & Natural Gas (>2500MW)	Coal (>2,500 MW)
Water cooling (open cycle)	M^3/kWh	0.18	0.00	0.15	0.11
Water (industrial)	M^3/kWh	0.001	0.0006	0.0001	0.0003
Fuels	Koe/kWh	0.24	0.16	0.18	0.25
	GJ/kWh	9.7	6.3	7.3	10.0
Material inputs (total)					
Lime	g/kWh	0.26	0.00	0.00	0.28
Ferric chloride	g/kWh	0.02	0.00	0.00	0.06
Ammonia	g/kWh	0.82	0.00	0.21	1.02
Caustic soda	g/kWh	0.02	0.00	0.01	0.01

Acids	g/kWh	0.03	0.00	0.01	0.34
Others	g/kWh	7.11	0.00	0.00	3.76
OUTPUTS					
Emissions					
SO_2	g/kWh	0.65	0.00	0.66	1.62
NO_x	g/kWh	0.61	0.20	0.23	0.98
Dust	g/kWh	0.05	0.0001	0.01	0.02
Water vapour	M^3/kWh	0.0004	0.0004	0.0001	0.0003
CO_2					
From combustion	g/kWh	936	366.07	616.67	920.00
From desulphurization	g/kWh	3	0.00	0.00	0.00
Waste water	M^3/kWh	0.0002	0.00013	0.00003	0.00002
Water cooling (open cycle)	M^3/kWh	0.18	0.00	0.21	0.11
Wastes					
Not hazardous wastes	g/kWh	61	0.4	0.09	50
Hazardous wastes	g/kWh	0.03	0.08	0.25	0.04
ELECTRICITY					
Wastes recovered					
Not hazardous	g/kWh	60	0.02	0	48
hazardous	g/kWh	0.002	0.004	0.000	0.01

Sources : personal elaboration of the authors

As reported, from this study emerges that few differences come out. It is interesting to observe that between the *coal power plants* the best indicators for the plants with EMAS are related to the consumption of limestone (3.76 g/kWh against 7.11 g/kWh), for the emissions of hazardous wastes (50 g/kWh against 61 g/kWh) and for the CO2 (920 g/kWh against 936 g/kWh). The NG power-plant has the best environmental *input indicators* that are null if compared with the coal power plants. Analyzing also the *outputs* the NG plant continues to have the best indicators. This is due to the difference of quality between the typology of fuels considering that is well known the environmental impact related to the coal. Comparing the emissions between the coal power plant with and without EMAS, we find that the emission of CO2, of hazardous and not hazardous wastes are lower than these of the coal plant without EMAS, but SO2 (1.62 g/kWh) and NOx (0.89 g/kWh) emissions are higher.

SECOND CASE STUDY IN THE TOURISM SECTOR

As above cited the Ecolabel award scheme is well integrated in Italy because is seen as a good opportunity for companies to increase their competitiveness. In order to verify whether environmental performance and reducing costs in the tourism sector have been recorded after its adoption, a questionnaire was sent to each of 58 hotels and than we have integrated the information with some interviews. The questionnaire was sent to certificated hotels (we ruled the bed & breakfast out from the investigation) with a feedback of 40%.

Results

The crucial questions related to our investigation were: a) the economic investment in obtaining the Ecolabel, b) whether after the Ecolabel have been recorded reduction in consumptions (water, energy, wastes), c) evident advantages after the Ecolabel. a) The economic investments depend on the number of mandatory criteria necessary to satisfy. From the data received has been possible to disaggregated the costs for each criterion and has been estimated a range of costs as showed in Table 4.

Table 4 Estimated costs for obtaining the EU Ecolabel

Investments for mandatory criteria	Costs in Euros
Renewable Energy (Recs certificates)	200.00
Lamps	1,680.00
Wastes	1,800.00

Dispenser	6,600.00
Plastic glass	500.00
Oil disposal	3,000.00
Paper office recycling	150.00
New lamp in the rooms (optional)	27,000.00
Consultant	6,000.00 – 7,000.00

Sources: Personal elaboration of the authors

As cited, the costs are linked to the mandatory changes necessary to be made in the hotel. In Table 4 we report also an optional criteria because, even if the expenditure is very high, normally the managers decide to make it because they have already considered the related positive effects of their consumption. This means that the costs in total are roughly _50,000.00.

The criterion "renewable energy" should cover roughly the 30% of the total supply of energy but has a cost lower than other allocations only because instead to install photovoltaic or biomass power-plant, which would be very expensive and very bureaucratic, it is possible to buy the Renewable Energy Certificates (RECs). These RECs are electronic form of currency initiated by the *Renewable Energy (Electricity) Act 2000* with the aim to encourage additional generation of electricity from renewable sources and to reduce greenhouse gas emissions. For each MWh of electricity generated from renewable energy sources one RECS-Certificate can be issued. For this reason a manager can choose this option for reducing costs. b) _he answer related to the cutting of consumptions (water, energy wastes and so on) has been important in understanding the effectiveness of the Ecolabel. After receiving data, based on the statistics of each hotel, we have calculated the percentage of savings as showed in Table 5.

Table 5 Savings of consumption after the Ecolabel

Consumption	% of savings
Water	15-18
Electricity	12-30
Thermal energy	12-15
Detergents	<20
Wastes	<10

Sources: Personal elaboration of the authors

As reported there is an evident advantage after adopting the Ecolabel. This means that its adoption induces significant improvements in the environmental performance. c) No one of the interviewed was able to record some tangible effects on the turnover. The managers interviewed claim that this is due to the lack of recognition and knowledge of the EU Ecolabel by different actors on the market, as consumers, intermediate customers and retailers. Furthermore they state that the potential market should be empowered through an effective campaign of information at European level. External incentives are also important, as fiscal incentives, tax abatement, or to include the Ecolabel logo as facilitating condition for public procurement.

CONCLUSION

This study has showed two different results of the analyzed sectors. The answer whether EMAS in the sector of power generation is an effective tool, is controversial: it is important to highlight that in the power-plant electric generation the economic investments are higher than other companies operating in different sectors that have obtained EMAS. The managers

interviewed are hopeful and positive and even if the environmental improvements are not so evident, they are sure that with the time will be reached significant results. Different outcome is registered in the tourism sector. In this case has been possible to record "in house" important environmental improvements, but the market benefits (increasing of in the market share, number of customers or the turnover) are lower then expected.

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TECHNOLOGY ACCEPTANCE AND RELATED MODELS: AN EXPLORATORY RESEARCH FOR INTERNET BANKING APPLICATIONS

Mantana Intana, Shinawatra University, Thailand
manin@samart.co.th
Chuvej Chansa-ngavej, Shinawatra University, Thailand
chuvej@shinawatra.ac.th

ABSTRACT

This paper intends to provide researchers who want to find a theoretical framework for measuring user behaviors related to perceived usefulness and perceived ease of use – the Technology Acceptance Model – as the basis for their investigation. The research traces the origin of Technology Acceptance Model (TAM): Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975, Ajzen and Fishbein, 1980), Theory of Planned Behavior (TPB) (Hernandez and Mazzon, 2007) and other extension models related to TAM including Model of Customer Trust for Online (Jarvenpaa et al., 2000), Theoretical Extension of Technology Acceptance Model or TAM 2 (Venkatesh and Davis, 2000), Unified Theory of Acceptance and Use of Technology (UTATU) (Venkatesh et al., 2003), Trust Enhanced TAM for Mobile Payment (Dahlberg et al., 2003), Extended TAM for Purchasing Online at an E-Commerce Website (Hejjden et al., 2003), Augmented TAM for Online Shopping (Vijayasarathy, 2004), TAMCom for Business to Customer (B2C) (Wong et al, 2008). Specifically, this research examines past researches using TAM in such areas of business and government as electronic commerce of small and medium business, online banking, and enterprise development as the basis for modeling an extension to TAM for empirical testing and use for a better understanding of e-banking in the context of such emerging economies as Thailand.

Keywords: Technology Acceptance Model (TAM), perceived usefulness, perceived ease of use, Internet Banking, Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB),

INTRODUCTION

Technology Acceptance Model (TAM) has been popularly used for predicting user acceptance and user adoption to use information technologies (Venkatesh and Davis, 1996). As Igbaria et al. (1995) stated, MIS researchers used TAM as a theoretical foundation on the factors affecting the user acceptance of computer technology. TAM is based on Fishbein and Ajzen's theory of reasoned action (TRA).

Huber (2001) indicated that to support organizational competitiveness in the market place, knowledge would be more and more recognized as a key organizational asset (as cited in Xu and Quaddus 2007). Xu el al. (2007) argued that "The need to effectively and systematically manage the knowledge will not diminish" (p. 57). TAM by Davis (1989) offered the valid measurement scales with high convergent, discriminating, and factorial validity which were better measures for predicting and explaining system use. Business who would like to assess user demand for new design ideas and managers within organizations who would like to evaluate these business offerings would find great practical value in the TAM.

The purpose of this research is to examine ways in which knowledge in the theoretical framework for assessing the influences of perceived usefulness and perceived ease of use on using electronic services of the TAM could be leveraged into the internet banking environment in Thailand. The investigation focuses on two theoretical constructs, perceived usefulness and perceived ease of use, which are theorized to be the fundamental determinants of system use or user acceptance (Davis, 1989). Other constructs will be described as it is very important to know how the factors affect user behavior.

BACKGROUND

Technology Acceptance Model or TAM (Davis 1986) is derived from the theory of Reasoned Action which was developed by Fishbein and Ajzen (1975). TAM was a big hit for modeling user acceptance of information systems (Davis and Bagozzi, 1989).

Theory of Reasoned Action (TRA)

Fishbein and Ajzen's (1975) and Ajzen and Fishbein's (1980) theory of reasoned action (TRA) is an especially well-researched intention model that has proven successful in predicting and explaining behavior across a wide variety of domains. TRA is very general "designed to explain virtually any human behavior" (Ajzen and Fishbein, 1980, p.4), and should therefore be appropriate for studying the determinants of computer usage behavior with internet banking using a Thai bank as a special case.

Xu and Quaddus (2007) proposed a model of the factors affecting the adoption and continued use of KMSs based on two models from social psychology: TRA (Ajzen & Fishbein, 1980) and TAM (Davis, 1986). Also, Xu and Quaddus (2007) described TRA that people consider the implications of their actions before they decide to engage or not to engage in a given behavior. The theory views a person's intention to perform (or not to perform) a behavior as the immediate determinant of the action. In addition, a person's intention is a function of two basic determinants, one "personal" in nature and the other reflecting "social influence." The personal factor is the individual's positive or negative evaluation of performing the behavior, which is called "attitude toward the behavior" and refers to attitudinal factors. The second determinant of intention is the person's perception of the social pressure put on him/her to perform or not to perform the behavior in question. The relative weight of the two determinants of intention is the solution for the situation of conflict between attitude toward the behavior and subjective norm. As a result, it is possible to predict and gain some understanding of a person's intention by measuring his or her attitude toward performing the behavior, his subjective norm, and the relative weights.

According to Hernandez and Mazzon (2007), Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen (1975), is probably one of the most influential theories used to explain human behavior. Simply the behavioral intention can be explained by the attitude towards behavior and subjective norm. The attitude towards behavior is defined as "an individual's positive or negative feelings about performing the target behavior". Subjective norm refers to perception that most people who really matter to the individual think that be either should or should not perform the behavior in question". Attitude towards behavior, in turn, can be explained by the salient beliefs in the behavior.

Davis et al. (1989) introduced an adaptation of TRA (Fishbein and Ajzen 1975, Ajzen and Fishbein 1980), the technology acceptance model (TAM), which is specifically meant to explain computer usage behavior. According to TRA, a person's performance of a specified behavior is determined by his or her behavioral intention (BI) to perform the behavior, and BI

is jointly determined by a person's attitude (A), an individual's positive or negative feeling (evaluative affect) about performing the target behavior, and subjective norm (SN), "the person's perception that most people who are important to him think he should or should not perform the behavior in question", concerning the behavior (Figure 1), with relative weights typically estimated by the equation:

$$BI = A + SN$$

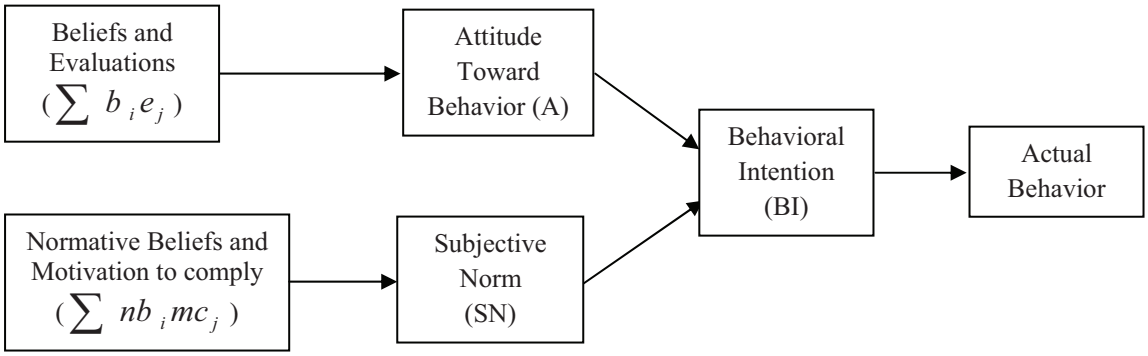

Figure 1 Theory of Reasoned Action (TRA)

$\sum b_i e_i$ is defined as the consequence of his or her salient beliefs (b_i), and the performing behavior multiplied by the evaluation (e_i).

$\sum nb_i\ mc_i$ is defined as a multiplicative function of his or her normative beliefs (nb_i) and his or her motivation to comply (mc_i).

Ajzen and Fishbein (1980) and Fishbein and Ajzen (1975) reported that many social psychologies broadly used TRA for studying model which is concerned with the determinants of consciously intended behaviors. TRA has broad applicability in diverse disciplines and has gone through rigorous testing that has proved its robustness in predicting intentions and behavior (Davis et al., 1989).

Theory of Planned Behavior (TPB)

Hernandez and Mazzon (2007) looked into the main features of the theoretical models most frequently used in the studies of innovation adoption. One is TPB which was proposed by Ajzen (1985) as an extension of TRA for situations where people did not have complete control over their behavior. Basically, TPB adds a determinant to the behavioral intention and the attitude towards behavior constructs which is the perceived behavioral control. This construct reflects how people perceive the internal and external limitations to their behavior. On more formal terms, it refers to how easy or difficult people believe it would be to perform certain behaviors.

In TPB, behavior itself is a function of both the behavioral intention and the perceived behavioral control. Behavioral intention, in turn, is influenced by the attitude towards behavior, the subjective norm and the perceived behavioral control, the determinants of intention (attitude, subjective norm, and perceived behavioral control) are established by the structure of the underlying (attitudinal, normative and control) beliefs.

Technology Acceptance Model (TAM)

TAM Description

Technology Acceptance Model was launched by Davis (1989) in an effort to find available measurement scales to predict user acceptance who uses online environment in the business. TAM is defined as the subjective norm construct for predicting user acceptance of computers using a valid measurement scales for two specific variables, perceived usefulness and perceived ease of use. According to Davis (1989), "Both are theorized to be fundamental determinants of system use (p. 320)". In additional Davis (1989) indicated two theoretical constructs that:

> First, people tend to use or not use an application to the extent they believe it will help them perform their job better. We refer to this first variable as *perceived usefulness*. Second, even if potential users believe that a given application is useful, they may, at the same time, believe that the systems is too hard to use and that the performance benefits of usage are outweighed by the effort of using the application. That is, in addition to usefulness, usage is theorized to be influenced by *perceived ease of use*.

Davis (1989) conducts two studies: Study 1 and study 2 to assess the relationship between usefulness, ease of use, and self-reported usage. For Study 1, two variables - perceived usefulness and perceived ease of use were conducted to assess the reliability, convergent validity, discrimination validity, and factorial validity of the 10-item scales resulting from the pretest. In Study 2, six items of two variables - perceived usefulness and perceived ease of use resulting from scale refinement in Study 1 were evaluated. Table 1 and Table 2 show the details and the summary results of the study.

Table 1 Comparing information between Study 1 and Study 2

	Study 1	Study 2
Objective	To assess the reliability, convergent validity, discrimination validity, and factorial validity	To approximate applied prototype testing or system selection situations, an important class of situations where measures of this kind are likely to be used in practice
Items assessed	10	6
Sample	112 obtained from 120	40
Participants	IBM Canada's Toronto Development Laboratory	Evening MBA students at Boston University
Experience with work	Managers (10 percent), Administrative staff (35 percent), Professional staff (55 percent)	Average of five years' work experience and were employed full-time in several industries
Industries	Market analysts, Product development analysts, Programmers, Financial analysts Research scientists	Education (10 percent), Government (10 percent), Financial (28 percent), Health (18 percent), Manufacturing (8 percent)
Experience with computers	Average of six months' experience with the two systems studied	A range of prior experience with computer in general: None or limited (35 percent) Moderate (48 percent) Extensive (17 percent)

	Study 1	Study 2
System available	1. PROFS electronic mail 2. XEDIT file editor	Based graphics systems: 1. Chart-Master 2. Pen-draw
Computing environment	IBM mainframes accessible through 327X terminals	IBM PC
Questionnaire	Circling a number from one to seven arranged horizontally beneath anchor point descriptions "Strongly Agree," "Neutral," and "Strongly Disagree."	One hour of hands-on experience with Chart-Master and Pendraw

Table 2 Comparing the result of Reliability and Correlations and Regression Analysis between Study 1 and Study 2

Cronbach Alpha Reliability	Study 1 PROFS electronic mail and The XEDIT file editor System	Study 2 Chart-Master and Pen-draw System
Perceived usefulness	.97	.98
Perceived ease of use	.91	.94
Correlations	Study 1 (n=184) Self-Reported Usage	Study 2 (n=80) Self-Predicted Usage
Perceived usefulness	.63	.85
Perceived ease of use	.45	.69
Ease of Use & Usefulness	.64	.56
Regression Analysis	Study 1 (n=184) Self-Reported Usage	Study 2 (n=80) Self-Predicted Usage
Perceived usefulness	.57	.75
Perceived ease of use	.07	.17
R^2	.38	.74

TAM Model Conclusion by Davis (1989)

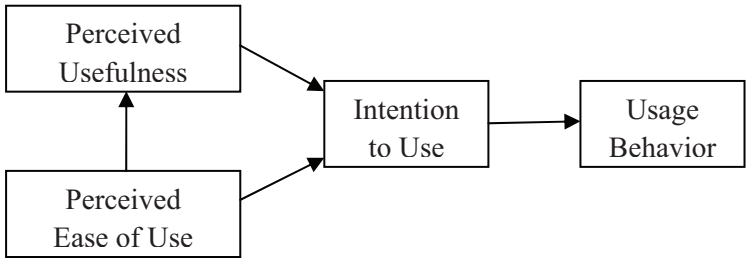

Figure 2 Technology Acceptance Model (TAM)

TAM was successful in several respects of computer usage:
(1) Have strong psychometric properties
(2) Exhibit significant empirical relationships with self-reported measures of usage behavior
(3) Characterize the nature of perceived usefulness and ease of use
(4) Establish determinants of user acceptance of technology

Further research is needed to present how other variables relate to usefulness, ease of use, and acceptance:

(1) Another limitation of the usage measures employed was the self-reported as opposed to objective measures.
(2) Know more about how accurately self-reports reflect to actual behavior.
(3) A halo effect should not be overlooked.
(4) Addressing the relationship between these constructs and objectively measured use is needed before claims about the behavioral predictiveness can be made conclusively.

Other Related Models

Model of customer trust (Jarvenpaa et al., 2000)

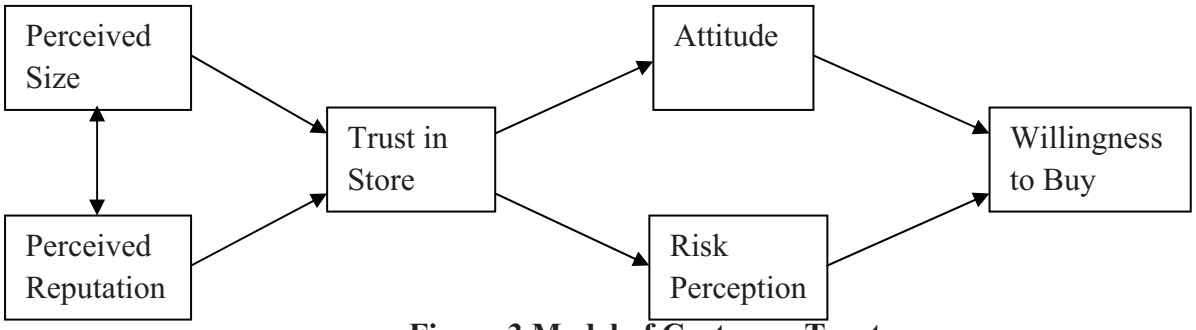

Figure 3 Model of Customer Trust

A model of consumer trust shown in Figure 3 was developed to explain consumer trust in an Internet-based store (Jarvenpaa et al, 2000). The trust factors are perceived size, that is the store's size from customer's perception, and perceived reputation, that is the store's reputation from customer's perception.

Their research indicated that there are no strong effects with antecedents of trust, but the proposed trust is positively associated with attitude in the customer's adoption of willingness to buy from an Internet store.

Augmented TAM for online shopping (Vijayasarathy, 2004)

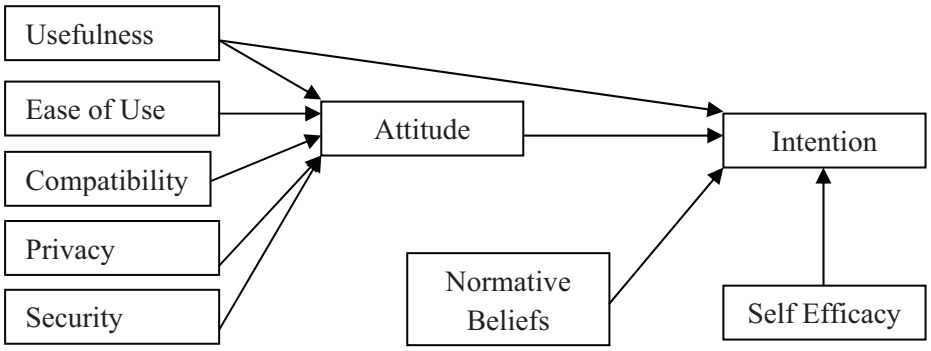

Figure 4 Augmented TAM for online shopping

Vijayasarathy (2004) introduced an augmented TAM shown in Figure to predict consumer intentions to use online shopping. New variables are included in an augmented TAM: privacy that is the degree to which personal information is protected; and security, that is defined as "the extent to which a consumer believes that making payments online is secure"; compatibility, normative beliefs, and self- efficacy. The findings indicated that

compatibility, usefulness, ease of use, and security were found to be significant predictors of attitude towards on-line shopping, but privacy was not. Further, intention to use on-line shopping was strongly influenced by attitude toward on-line shopping, normative beliefs, and self-efficacy.

A Theoretical Extension of the Technology Acceptance Model or TAM2 (Venkatesh, Davis, 2000)

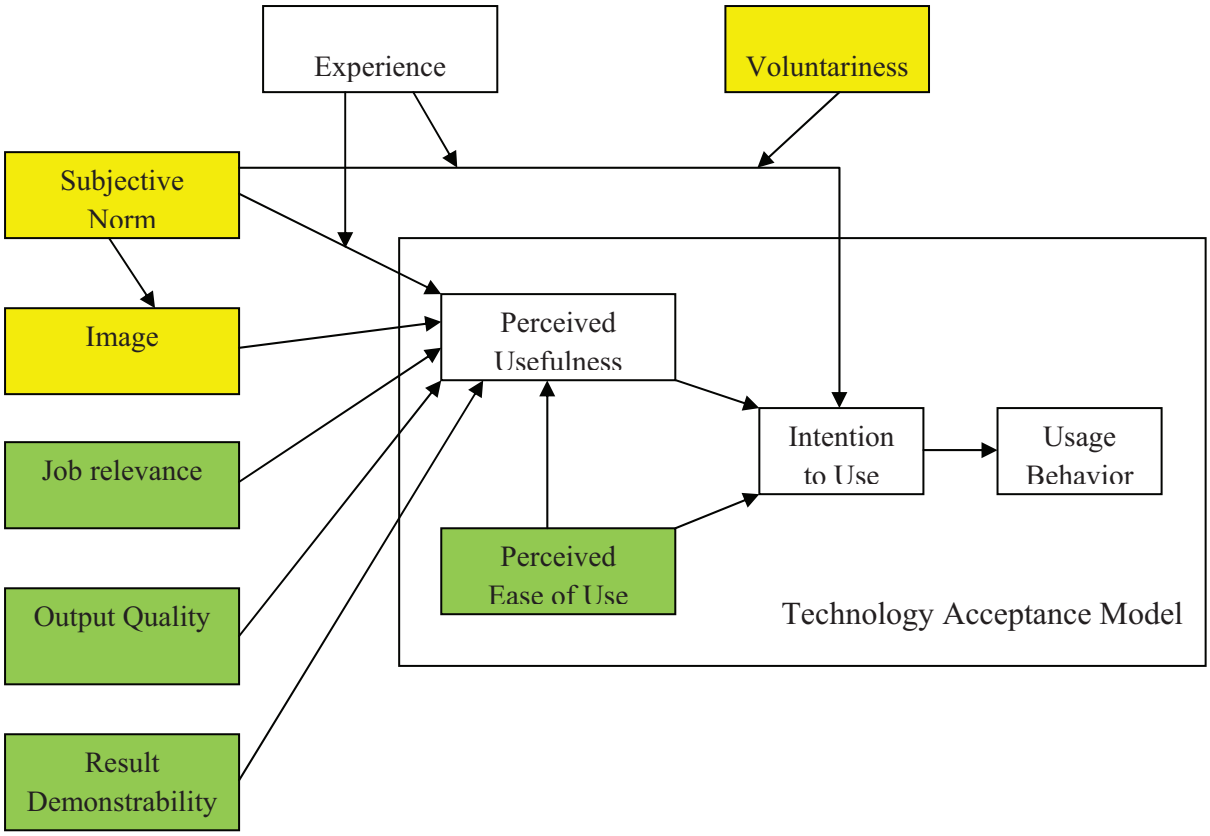

Figure 5 TAM2 – Extension of the Technology Acceptance Model

TAM 2 Model explains perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes. Both social influence processes including subjective norm, voluntariness, and image and cognitive instrumental processes including job relevance, output quality, result demonstrability, and perceived ease of use significantly influenced user acceptance.

Also, user perceptions of result demonstrability and ease of use were significant, unlike social influence processes, the effects of cognitive instrumental processes remained significant over time.

The term Social influences is defined as "influence to accept information from another as evidence about reality" affecting perceived usefulness and usage intention.

Subjective norm is defined as a "person's perception that most people who are important to him think he should or should not perform the behavior in question."

Voluntariness as a moderating variable, is defined as a "the extent to which potential adopters perceived the adoption decision to be non-mandatory."

Image is defined as the degree to which use of an innovation is perceived to enhance one's status in one's social system."

Job Relevance is defined as "an individual's perception regarding the degree to which the target system is applicable to his or her job."
Output Quality is defined as "people will take into consideration how well the system performs the tasks."
Result demonstrability is defined as the "tangibility of the results of using the innovation."

The Unified Theory of Acceptance and Use of Technology (UTAUT)
(Venkatesh et al., 2003)

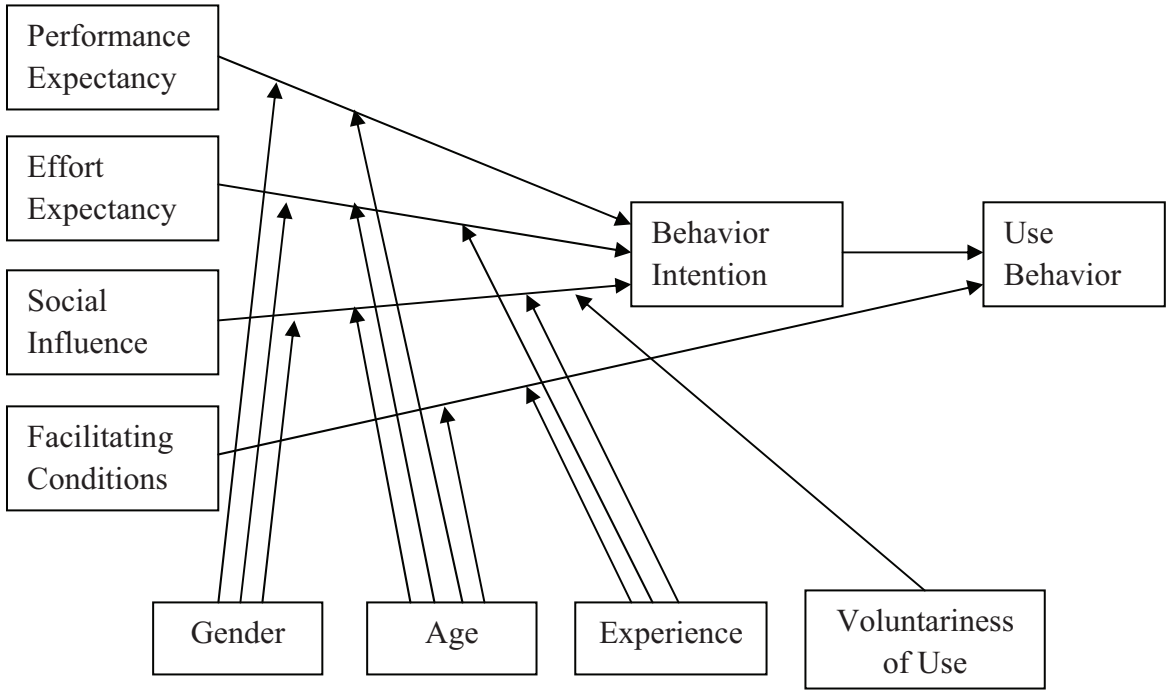

Figure 6 Unified Theory of Acceptance and Use of Technology (UTAUT)

This research traces on individual acceptance of information technology into a unified theoretical model that captures the essential elements of eight prominent established models: the theory of reasoned action; the technology acceptance model, the motivational mode; the theory of planned behavior; a model combining the technology acceptance model and the theory of planned behavior; the model of PC utilization; the innovation diffusion theory; and the social cognitive theory. The conceptual and empirical similarities across the eight models are used to formulate the UTAUT with four core determinants of intention and usage behavior: performance expectancy; effort expectancy; social influence; and facilitation conditions, and up to four moderators (gender, age, voluntariness, and experience) of key relationships. The result found that attitude toward using technology, self-efficacy, and anxiety are theorized not to be direct determinants of intention. UTAUT provides a usual tool for managers needing to assess the likelihood of success for new technology introductions and helps them understand the divers of acceptance in order to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems.

Trust Enhanced TAM for mobile payment (Dahlberg et al, 2003)

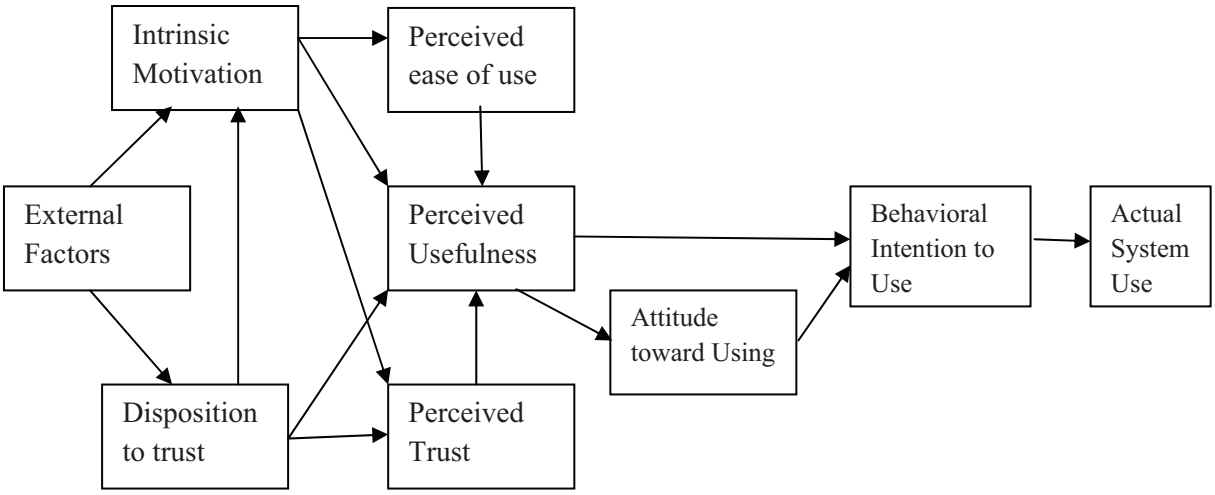

Figure 7 Trust Enhanced TAM for mobile payment

Dahlberg, et al. (2003) introduced a trust-enhanced TAM shown in Figure to explain mobile payment solutions. The trust factors are perceived trust, which is the degree to which a person perceived a particular technology solution as secure and trustworthy, and disposition to trust, that is the extent to which a person is willing to trust others. The finding indicated that the proposed trust factors play an important role in customer adoption of mobile payment solutions.

Extended TAM for purchasing online at an e-commerce website (Hejjden et al, 2003)

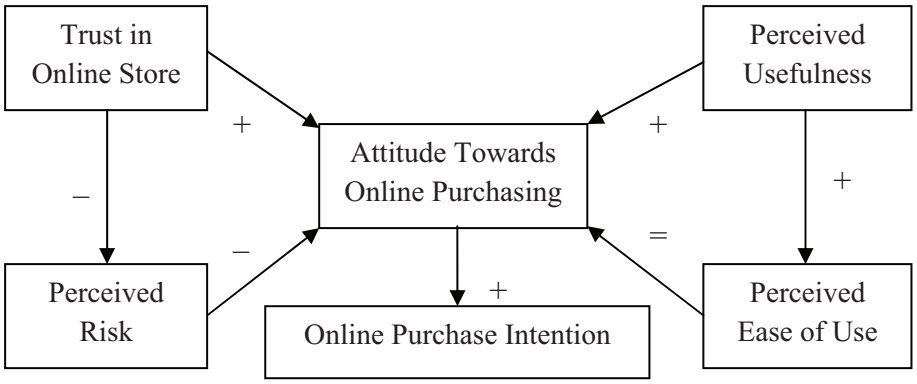

Figure 8 Extended TAM for purchasing online at an e-commerce website

An extended TAM shown in Figure 8 has been used to explore factors that influence consumer's intentions in consumer markets to purchase online at an electronic commerce website. This extended TAM adopted the *trust*-oriented perspective which means that 'the willingness of a consumer to be vulnerable to the actions of an online store based on the expectation that the online store will perform a particular action important to the consumer, irrespective of the ability to monitor or control the online store'. Consequently, the existing empirical evidence suggests that trust in the company negatively influences the perceived risk that is associated with buying something on the internet. Perceived risk can be regarded as a consumer's subjective function of the magnitude of adverse consequences and the probabilities that these consequences may occur if the product is acquired. The key finding

suggests that perceived risk and perceived ease-of-use are antecedents of attitude towards online purchasing. The effect of perceived risk was strongly negative in both cases, and the effect of perceived ease-of-use was positive in one case. Trust in store appears to be indirectly related to a positive attitude through its direct negative effect of perceived risk.

Technology Acceptance Model (TAMCom) for Business to Customer (B2C) E-Commerce (Yuk Kuen Wong et al, 2005)

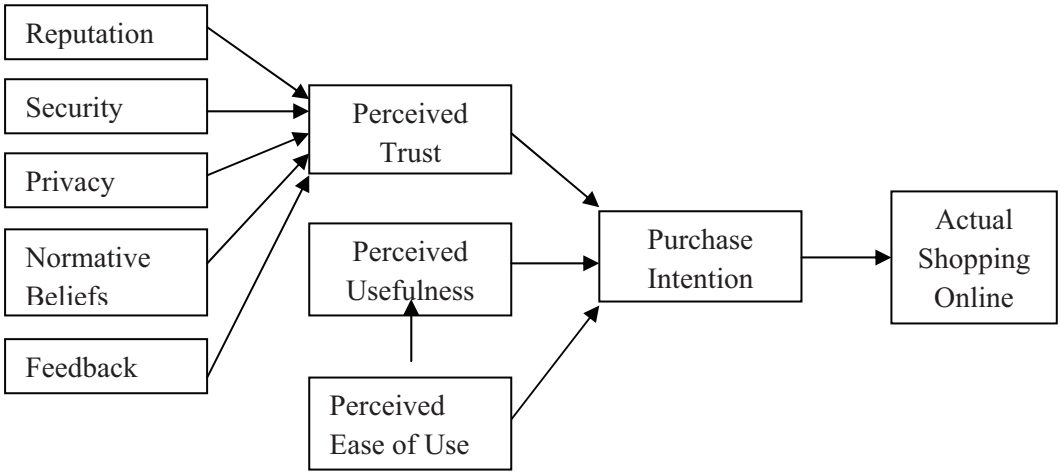

Figure 9 Technology Acceptance Model orTAMCom for Business to Customer (B2C)

TAM for E-Commerce or TAMCom shown in Figure 9 was developed to enhance and advance the traditional model. This new model has provided further identification of the critical factor of trust, for analyzing e-commerce success. In summary, the major contributions of the work are threefold. First, TAMCom was developed from the literature and theory for analyzing e-commerce success. Second, TAMCom model also enhances the traditional technology acceptance model. In addition, TAMCom allows managers to further analyze and to understand the important relationships between trust and e-commerce success.

Extended TAM for Internet Banking (Ndubisi 2007)

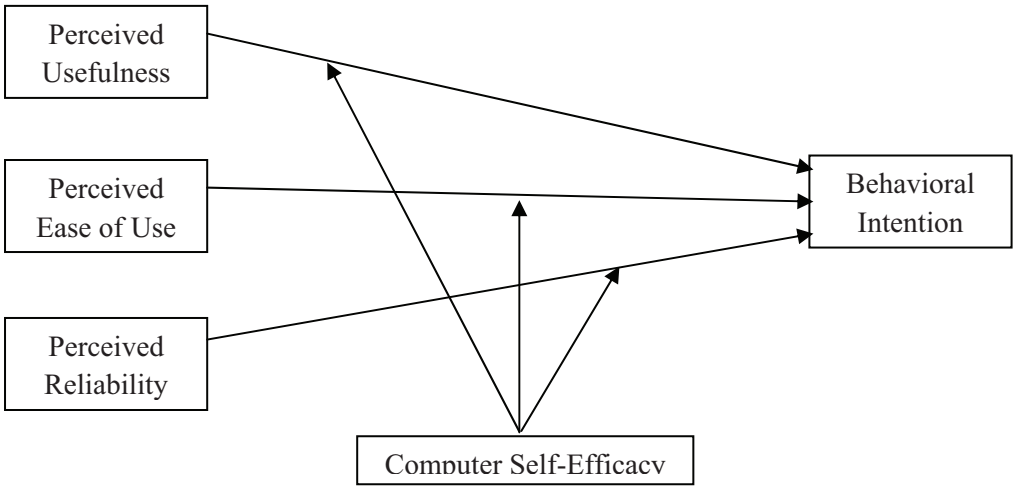

Figure 10 Extended TAM for Internet Banking

The extended TAM scrutinizes the moderation effect of computer self-efficacy on perceptions-intention relationships. The first two factors, the most important constructs in TAM are perceived usefulness and perceived ease of use. The next construct, for extending TAM, is perceived reliability, the usage intention of internet banking which could be affected by users' perceptions of reliability relating to constancy, trustworthiness and privacy matters. The majority of users of computer systems are relatively ignorant or careless about the reliability of the system they use. The last extended construct is CSE, defined as the judgment of one's ability to use computer. Many studies confirm the important effect of CSE in understanding individual responses to IT and shown that there is a positive relationship between experience with computing technology, perceived outcome and usage.

Extension of TAM for online banking acceptance (Pikkarainen et al., 2004)

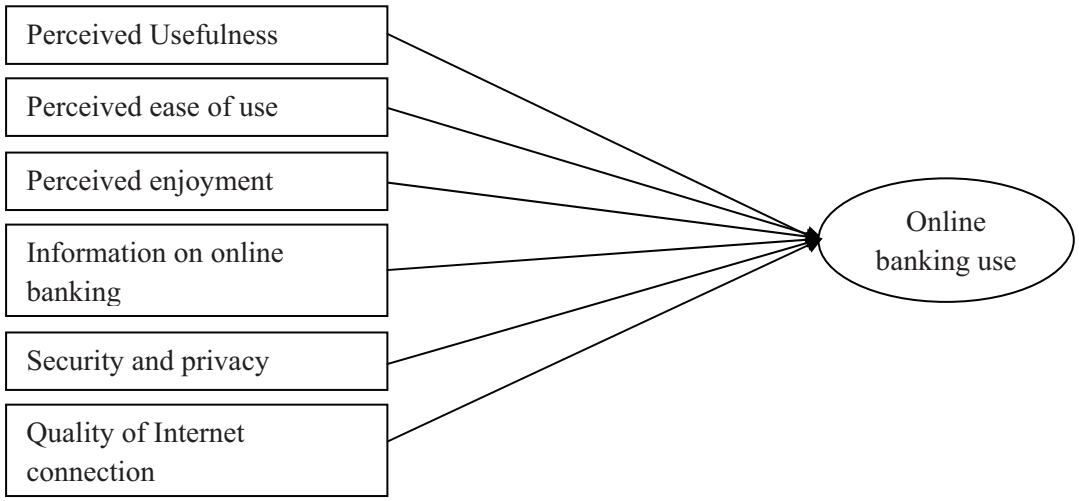

Figure 11 The Extension of TAM for Online Banking Acceptance

Based on Pikkarainen et al., (2004), the extension of TAM suggest five factors consists of Perceived usefulness, Perceived ease of use, Perceived enjoyment, information on online banking, and security and privacy. All have an impact on the acceptance of online banking, but the factor referring to quality of Internet connection did not suite in the model with the fact that reliable Internet connections have become so common place among the respondents. The result also confirmed that information about online banking services and its benefits is a critical factor influencing the acceptance. Moreover, security and privacy were found to have a relatively weak relationship with the acceptance which is the contrary to many researches during the past years.

Past Research Reference to TAM in E-Business

Strategic Value and Adoption of Electronic Commerce: An Empirical Study of Chilean Small and Medium Business (Grandon, Pearson, 2003)

This research attempts to identify specific relationships between a manager's perceptions of the strategic value of e-commerce and the variables that may influence e-commerce adoption. Four different sub-constructs was set including organizational readiness, external pressure, perceived ease of use, and perceived usefulness. The conclusion implies that managers must believe that e-commerce can add strategic value to their organization before they undertake an e-commerce initiative. That is critical components to its success.

An investigation of Factors that Influence Senior Executives to Accept Innovations in Information Technology (Pijpers, Montfort, 2006)

This research need to present the successfully and effectively use of innovations by the role of acceptance especially for innovations in the field of Information Technology (IT). TAM is used as the key measure of success to investigate empirically the factors which influence the IT acceptance and actual IT use of senior executives. The study results provide support for the core TAM model as an adequate and parsimonious conceptualization of acceptance behavior and the salience of usefulness and ease of use beliefs. The conclusion suggests that computer anxiety of senior executives can be diminished and computer self efficacy improved.

Adoption of internet banking: proposition and implementation of an integrated methodology approach (Hernandez, Mazzon, 2007)

This study proposes a new method to investigate innovation adoption of new technologies and tests the factors that influence adoption by looking into the determinants of internet banking adoption in Brazil. The adoption determinants are based on beliefs, attitudes, subjective norm, and perceptions of behavioral control. The results proved that the variables that influence adoption are determined through analyzing not only intention measures but also actual adoption. Results have also led to the identification of a broad set of variables that proved significant in influencing both the intention to use or continue to use internet banking and actual internet banking adoption in Brazil.

The mediation of external variables in the technology acceptance model (Burton-Jones, Hubona, 2006)

The research tested one of its assumptions that the 'perceived ease of use' and perceived usefulness' constructs fully mediate the influence of external variables on usage behaviors. The result of TAM is significantly and consistently better at predicting frequency than volume of usage.

Computer self-efficacy levels, perceptions and adoption of online banking (Guriting, Chunwen, 2007)

The research examines the role of Computer Self-Efficacy (CSE) at three distinct levels of user perceptions (low, mid and high) and the adoption of online banking. The study employs the extended Technology-Acceptance Model (TAM) as the theoretical framework. It was found that perceived usefulness and perceived ease of use were strong determinants of the behavioral intention to adopt internet banking, CSE was more important at low and mid levels of user-perceived usefulness and ease of use than at high level of perception.

Internet Banking Adoption among Young Intellectuals (Amin, 2007)

Amin study technology acceptance of internet banking among undergraduate students in Malaysia based on modified version of Technology Acceptance Model (TAM) to explain the factors influencing undergraduate students' acceptance of internet banking. All four measures: perceived usefulness (PU), perceived ease of use (PEOU), perceived credibility (PC), and computer self-efficacy (CSE) included in the model that better reflects the students' view. The result suggest that PU, PEOU and PC had a significant relationship with behavioral intention and PU and PEOU had a significant relationship with CSE. On the

contrary, CSE did not associate with PC. Also PEOU had a significant relationship with PU and PC that indicate these scales are related to PEOU in explaining undergraduate preference.

Exploring the Factors Influencing End Users' Acceptance of Knowledge Management Systems: Development of a Research Model of Adoption and Continued Use (Xu and Quaddus, 2007)

This research develops a model of adoption and continued use of knowledge management systems (KMSs), which is primarily built on Rogers' (1995) innovation stages model along with two very important social psychology theories – Ajzen and Fishbein's (1980) theory of reasoned action (TRA) and Davis's (1986) technology acceptance model (TAM). KMSs presents various factors and variables including individual differences factor, organizational factors, task complexity factors, organic growth factors, perceived benefits, perceived user friendliness, perceived voluntariness, subject norm, adoption of KMS, organizational facilitation, realized benefits, and realized user friendliness. The proposed model has both theoretical and practical implications. It can be adapted for application in various organizations in national and international arena: communication with knowledge holders; knowledge sharing; contribution to the systems; codifying and storing knowledge; knowledge creation; and KMS use habit.

A confidence-based framework for business to consumer (B2C) mobile commerce adoption (Wong and Jung Hsu.,2008)

TAM may not fully explain the consumers' behavior in an emerging environment, such as mobile commerce (m-commerce). TAM has been adopted and extended to analyze successful m-commerce adoption. The key elements of the proposed confidence-based framework for B2C m-commerce adoption include psychological and behavioral factors. Psychological factors include history-based confidence, institution-based confidence and personality-based confidence. Behavioral factors include perceived ease of use and perceived usefulness of the mobile application and technology.

FUTURE TREND AND CONCLUSION

This exploratory research sheds light on an approach based on the conceptual framework which facilitates the accumulation of knowledge in the TAM and the related area. The study could benefit those who are interested in analyzing the various phenomena of user behavior. According to Davis et al. (1989), there are three main insights concerning the determinants of managerial computer use: people's computer use can be predicted reasonably well from their intentions., perceived usefulness is a major determinant of people's intentions to use computers, perceived ease of use is a significant secondary determinant of people's intentions to use computers. Therefore, all of these relevant factors are concerned with predicting whether the new system will be acceptable to users or to enhance the business investment in time and money to introduce new information technologies into organizations. TAM has continued to be used as a basis for predicting behavior intention. Also, TAM has further been developed by adding other factors to extend TAM for their research. Moreover, the Internet continues to be expanded and new applications offered to business for commercial use. More and more companies are using the internet to conduct their business. E-commerce brings the universal access of the Internet which is the business process of buying and selling goods and services. E-commerce can save time and provide independence of location and time of day for customer reach, enrich the customer experience by offering

detailed product information, advice from experts, personal customized service, quick responses to complaints deliver a secure and fast transaction, enable the downloading of digital products, and supply more services (Suh and Han, 2002; Vajayasarathy, 2004). The growth of E-commerce and mobile commerce, which nowadays is going to be more and more popularized, is likely affected by perceived ease of use and perceived usefulness as a foundation of factual knowledge to predict user behavior.

MANAGERIAL IMPLICATIONS

The present research would help contribute to a better understanding of factors affecting the adoption of internet banking systems. In particular, this would eventually lead to an extension to the technology acceptance model, especially as it applies to such emerging markets as Thailand. Major outcomes expected from such understanding would be in the better design of internet banking systems that would lead to increased acceptance of internet banking among target customers. In turn, this would bring about increased income and cost reduction for the relevant banks. Conceivably, knowledge of the factors influencing such adoption would have implications for the adoption of other innovative technologies as well.

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THE EFFECT OF DIVERSIFICATIONS ON THE PERFORMANCE AND RISKS OF BANKS AND CREDIT UNIONS IN TAIWAN

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Chi-An Wang, National Taipei University of Technology, Taiwan
Spiceandy84@hotmail.com

ABSTRACT

Due to the competitiveness become more serious than ever in financial industry, financial organizations are doing more and more diversification to earn more operating income. But different studies and researches usually came out vary results. This study examines the banks and credit unions, two important types of financial organizations in Taiwan's economy, doing diversification would give what kind of impact to their financial performance and risk. We choose 36 banks and 27 credit unions in Taiwan and collect 4-year period data from 2005 to 2008. There are two different diversification variables- Herfindahl-Hirschman index and Non-interest income to operating income ratio. Then we use Hansen's (1999) Panel Threshold Regression Model to test if there are thresholds when financial organizations do diversifications. We find when banks and credit unions do more diversification it would influence their Risk-adjusted rate of ROE and Z-score significantly. So making decisions of doing diversifications becomes a very important idea for management of banks and credit unions. The findings can help researchers to understand that different types of financial institutions may optimally choose different degrees of diversification, which sheds some light on the inconsistent findings in the literature regarding the relationship between diversification and firm values.

Keywords: Diversification, Panel Threshold Regression Model, Non-interest Income, Performance, Insolvent Risk

INTRODUCTION

For the recent decades in Taiwan, financial industry, which includes banks and credit unions, has always been playing a very important role in the economic development. Banks and credit unions are the intermediate organizations that bring money borrowers and lenders together. And the traditional income sources of these two financial corporations are the interest income. After the government adopted the policy of liberalization and internationalization in the recent years, financial industry of Taiwan has undertaken several impacts. The most important one is the number of financial corporations boosted significantly.

Because of that, the environment has become more competitive than ever.

The serious problem of the financial environment has existed for years. Banks and credit unions in Taiwan then reduce their lending interest rates and enhance saving interest rates in order to strengthen themselves and take up more customers. But that will lead to the consequences of decreased income. Because the profit decreased and the risk rose, banks and credit unions try to diversify their scope of products and services, and to use information technology to create various earning sources. Via diversification, they expect to discover wider range of businesses and to achieve the scope economy.

Commercial banks offer many financial products and services, such as, credit card, cash card, trust fund, derivative financial products, securitization financial products, financial planning services, etc., to make their income sources vary. On the other hand, credit unions in Taiwan usually provide simple business services such as lending money to household unit and small and medium enterprises. As the competition arises, they also perform certain diversifications, such as the credit card of the National Federation of Credit Unions and the insurance services.

The diversification of banks and credit unions means that they not only do their traditional interest-earning activities, but also bring out more non-interest activities to earn non-interest income. So we take the ratio of non-interest income to total income as the proxy variable to measure the degree of diversification. When the non-interest income increases, the degree of diversification increases as well. Moreover, Herfindahl-Hirschman Index (HHI), which is a common used diversification ratio, also gives people sign to know whether the degree of banks and credit unions diversification is high or low. Here HHI is also calculated by the non-interest income. So non-interest income is a very important element for us to measure the diversification.

Should banks and credit unions diversify their portfolios across different industries or even broader economic sectors and geographical regions, or should they focus on a few related fields? The focus versus diversification issue is important in the context of banks and credit unions as they are affected by several regulations that create incentives either to diversify or to focus their portfolios, i.e. the imposition of capital requirements tied to the risk of the banks and credit unions' assets or asset investment restrictions. Hence, policymakers should be especially interested to see whether or not banks benefit from diversification.

As long as banks and credit unions earn more from the non-interest income, it is always interesting to know whether diversifications would have a positive or negative influence on their revenue and risks. In recent years, some researches of banking diversification came out

with different conclusions. And there has been little study regarding the diversification effect on the credit unions in Taiwan. The purpose of this study is to examine the diversification effect on the performance and risks of banks and credit unions respectively. Then we compare the difference between these two parties, and give suggestions and conclusions.

The remainder of the paper is organized as follows. Section 2 reviews the prior literature and Section 3 explains describes the dataset, variables, and the methodology that we adopted. We present empirical results in Section 4 and offer concluding remarks in Section 5.

LITERATURE REVIEWS

Diversification in banks and credit unions can be viewed as three-dimensional: across financial products and services; through geographic expansions, and through a combination of geographic and business line diversification. Nevertheless, the concept of financial organizations is still the same. Studies of cross-functional mergers provide mixed results.

From a theoretical standpoint, the decision to diversify income sources is desirable for both efficiency and risk management. The joint production of a wide range of financial services should increase a bank's efficiency (Klein and Saidenberg 1997). Thus, generally speaking, diversification across new types of services should enhance profitability.

When researchers consider risk, it is generally believed that diversification of income sources—that is, the shift from interest to non-interest income—should reduce total risk. Here, the idea is simple: since activities that generate non-interest income are thought of as uncorrelated, or, at least, imperfectly correlated, with those that produce interest income, diversification should stabilize operating income and give rise to a more stable stream of profits.

Empirical research has examined the issue of diversification benefits from several standpoints and through different methodological approaches. In spite of what economic theory postulates, namely, a positive relation between diversification and profitability, it has produced evidence that is by no means clear cut. An exhaustive survey of the literature on bank product mix and bank risk goes beyond the purpose of this paper (for such a survey see, for instance, DeYoung and Roland 2001). Here, we are interested only reviewing the most recent papers and comparing the findings for the U.S. and the EU. In fact, most of the studies that we review deal with U.S. banks (DeYoung and Roland 2001; Stiroh, 2004; DeYoung and Rice 2004; Stiroh and Rumble 2006), but to the best of our knowledge, only a few papers focus on the experience of European banks (European Central Bank 2000; Smith et al. 2003)

and none of them uses econometric methods.

Stiroh (2004), considering U.S. banking data between 1984 and 2001, finds that in the aggregate, industry-wide level, the correlation between net interest income growth and noninterest income growth increased in the 1990s; moreover, that non-interest income is much more volatile than net interest income, Further, that the lowering of operating revenue volatility, which occurred in the 1990s, can be traced directly to the declining volatility of net interest income. Finally, Stiroh finds that at the bank level, risk-adjusted returns are negatively associated with non-interest income shares.

DeYoung and Rice (2004), using data for U.S. commercial banks between 1989 and 2001, find that marginal increases in non-interest income were associated with higher profits, more variable profits, and on net, a worsening of risk–return trade off.

Stiroh and Rumble (2006), in a study on U.S. financial holding companies for the 1997–2002 period, find that there is no link between diversification and performance, but that there is a large negative relation between non-interest share and performance.

Smith et al. (2003) analyze the variability of interest and non-interest income and their correlation, for the banking systems of the 15 EU countries during the 1994–1998 period. For each country, Smith considers commercial, savings, cooperative, and mortgage banks on the one hand and large and small banks on the other, and study the correlation of income sources. They find that in the majority of the cases, the increased reliance on activities that generate non-interest income has stabilized profits.

Mercieca, Schaeck, and Wolfe(2007) took ROE and ROE to measure the performances of banks, HHI to measure the risk and degree of banks' diversification, Z-score to measure banks' insolvent risks. They research annual data for small European banks for the period 1997–2003 from bank scope and classify small banks as credit institutions with an asset size less than €450 million and no multi-bank affiliation. They find that when non-interest income increases, it doesn't help significantly with the small banks' performances, but with positive influence to large banks' ones.

As far as we are aware, Esho et al.'s (2005) and John Goddard, Donal McKillop, John O.S. Wilson (2007) are the only two empirical investigations of the impact of diversification on the financial performance of credit unions. Within Esho et al.'s research, over the period 1993–2001 an increased reliance on fee income generating activities was associated with increased risk. Credit unions with more highly concentrated income streams tended to have

higher risk and returns. Those with a higher proportion of total income from interest on residential loans, and a lower proportion of income from interest on personal loans, had significantly lower risk and returns. Credit unions that diversified by increasing the share in income of transaction fees on loans and deposits, matched by a reduction in the income share of interest on personal loans, experienced higher risk and lower returns.

And John Goddard, Donal McKillop, John O.S. Wilson (2007) collect the data from National Credit Union Association and Callahan & Associate's 5300 Call Reports between 1993 to 2004. And use the cross-sectional data to do the regression and analysis the financial performances. They adopt 6 indicators, they are ROA, ROE, σ_{ROA}, σ_{ROE}, risk-adjusted ROA(RAR_{ROA}), and risk-adjusted ROE (RAR_{ROE}). The result shows that if the credit unions' portfolio is similar, increasing non-interest income will increase the volatility of returns. And larger credit unions are more benefit from the diversification. Small ones should just focus on what they originally do.

METHODOLOGY

This section discusses the methodology that we apply on this paper. Firstly, it briefly review the building procedure for Panel Threshold Regressions based mainly on Hansen (1999), thereafter turning to the empirical specification.

Panel Threshold Regression Model

Threshold regression models allow individual observations to be divided into regimes based on the value of an observed variable. Firstly introduced into univariate time series context (TONG, 1983), the seminal paper of Hansen (1999) introduced the econometric techniques appropriate for threshold regression with panel data. Allowing for fixed individual-effects the PTR model divides the observations into two or more regimes depending on whether a threshold variable is smaller or larger than a threshold value, and these regimes are distinguished by differing regression slopes.

Hansen (1999) provides a two-regime balanced panel structural equation as follows:

$$y_{it} = \mu_i + \beta_1' x_{it} I(q_{it} \le \gamma) + \beta_2' x_{it} I(q_{it} > \gamma) + e_{it} \quad (2.1)$$

where y is the dependent variable and x is the vector of independent variables. Term is the cross-sectional unit of state, t is the year of observed data, μ_i is the individual-specific means, q_{it} is the threshold variable, and I(.) is the indicator function. This equation can be rewritten as:

$$y_{it} = \mu_i + \beta' x_{it}(\gamma) + e_{it} \quad (2.2)$$

where $\beta = (\beta_1', \beta_2')$ and $x_{it}(\gamma) = \begin{bmatrix} x_{it} I(q_{it} \le \gamma) \\ x_{it} I(q_{it} > \gamma) \end{bmatrix}$ (2.3)

Let Y, X, and denote the data stacked over all individuals:

$$Y^* = X^*(\gamma)\beta + e^* \quad (2.4)$$

and the coefficient β estimated by OLS:

$$\hat{\beta}(\gamma) = (X^*(\gamma)' X^*(\gamma))^{-1} X^*(\gamma) Y^*$$

and the sum of squared error (SSE) is:

$$S_1(\gamma) = \hat{e}^*(\gamma)' \hat{e}^*(\gamma)$$

$$= Y^{*'} \left(I - X^*(\gamma)(X^*(\gamma)' X^*(\gamma))^{-1} X^*(\gamma)' \right) Y^*$$

where

$$\hat{e}^*(\gamma) = Y^* - X^*(\gamma)\hat{\beta}(\gamma)$$

It is important to determine whether the threshold effect is statistically significant. The null hypothesis of no threshold effect (linearity) is:

$$H_0 : \beta_1 = \beta_2$$

Rejecting implies that there is one threshold at least. Hansen (1999) suggests the F test is:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2} \quad (2.5)$$

where S_0 is the SSE obtained from the estimative of (2.1) under the null hypothesis of no threshold, S_1 is the SSE obtained from the PTR estimative of (2.1), and $\hat{\sigma}^2$ is the residual variance of the PTR regression.

It is possible that the model includes more than one threshold. We first employ the F_1 test to assess the null hypothesis. If this null hypothesis is rejected, then at least one threshold is ensured. We then continue testing the null of one threshold against the alternative of two thresholds – that is:

$$F_2 = \frac{S_1(\hat{\gamma}_1) - S_2^r(\hat{\gamma}_2^r)}{\hat{\sigma}^2} \quad (2.6)$$

where γ_2 is the second threshold. A significant F_2 implies the rejection of the null of one threshold. Therefore, we can repeat this procedure to test the null of more thresholds. The critical values are computed based on the bootstrapping method. If the model exists with a threshold effect, then the next step is estimating the threshold value $\hat{\gamma}$. Hansen (1999) provides a method to form an asymptotic confidence interval for $\hat{\gamma}$ which is to form the no-rejection region $c(\alpha)$:

$$LR_1(\gamma) = \frac{S_1(\gamma^*) - S_1(\hat{\gamma})}{\hat{\sigma}^2} \tag{2.7}$$

$$c(\alpha) = -2\log(1-\sqrt{1-\alpha})$$

where $S_1(\gamma^*)$ and $S_1(\hat{\gamma})$ are the residual sum of squares given the true threshold γ* and $\hat{\gamma}$ estimated, and $(1-\alpha)$ is the set of values of γ such that $LR_1^r(\gamma) \le c(\alpha)$, respectively. If two thresholds cannot be rejected, the confidence intervals can be set in the same way:

$$LR_2^r(\gamma) = \frac{S_2^r(\gamma) - S_2^r(\hat{\gamma}_2^r)}{\hat{\sigma}^2} \tag{2.8}$$

where $S_2^r(\hat{\gamma}_2^r)$ is defined in (2.6).

Sample Selection and Data

We use financial data from Taiwan Economic Journal, and Market Observation Post System database of regional banks and credit unions in Taiwan. The samples used in this study are the 36 banks and 27 credit unions in Taiwan from 2005 to 2008. Those banks are selected because they have the complete 4 period data for 4 years. So we exclude some banks those don't have complete data. Beside that, the credit unions in Taiwan are all selected. We use annual data so there are 252 data.

Variables

Dependent Variables: Risk-adjusted rate of ROE, Z-score

(1) Performance Variable: Risk-adjusted rate of ROE (RAR_{ROE})
ROE is mean value of return on equity. It is the ratio of net income (after loan-loss provisions) to net worth or capital, defined as the sum of reserves, undivided earnings, loan and investment loss provisions, accumulated unrealized gains on securities and uninsured secured capital. For each bank and credit union, we calculate the average ROE over the quarters in a bank or credit union's lifetime or a given year. For each bank and credit union, we also calculate the standard deviation of σ_{ROE} over the same lifetime or year to measure the total volatility of profits. These variables define risk-adjusted return on equity, RAR_{ROE}. The equation is as follows:

$$RAR_{ROE} = \frac{ROE}{\sigma_{ROE}}$$

(2) Risk Variable: Z-score

Z-score is used to measure risks in this study due to that learning the insolvent possibility when banks and credit unions take diversification activities is crucial for investors. Take the year 2008 as an example, a large proportion of financial crises and bankruptcies arose from those companies that took too much financial leverage activities. And financial leverage activity is similar to diversification activity in some aspect. So we take Z-score to measure the risk of banks and credit unions.

The regulator may not care about the actual level of risk but put their eyes on a bank's distance to default. It's a potential criticism of an asset return volatility risk which is usually used to measure a bank's bankruptcy probability (Bouwman, 2004). How closer to failure is generally measured by an index which is called Z-score, introduced by Altman (1968). The Z-score estimates the number of standard deviations below the mean by which profits would have to fall before equity becomes negative. Boyd and Graham (1986) adopt the following equation to examine the risk of failure at large BHCs that diversified into non-banking activities during the 1970s and early 1980s,

$$Z_i = \left(\left\{\sum_{j=1}^{n}\left[2\pi_j/\left(A_j + A_{j-1}\right)\right]\right\}/n + \left\{\sum_{j=1}^{n}\left[\left(E_j + E_{j-1}\right)/\left(A_j + A_{j-1}\right)\right]\right\}/n\right)/S_r$$

where π is net income after taxes, A is total assets, E is total equity, Sr is the standard deviation of π/A, and the subscript j denotes the time period. High values of Z-score are associated with low probabilities of failure and the Z-score approach is frequently used in banking studies.

Threshold Variable: DIV

Both of Threshold Variable that we use the same variable to analyze the degree of diversification is because we want to know at what certain level of diversification will influence our dependent variables. We define Threshold Variable as DIV. And the DIV variable can be two as follow:

(1) Herfindahl-Hirschman index (DIV_{HHI})

The early studies on non-financial industries diversification were based on SIC codes with segmental accounting data. But the degree measurement of SIC-code classification for banks is not granular enough and is not consistent across countries. Moreover, segmental reporting is not consistent across banks and across time (Elsas, Hackethal, Holzhäuser, 2006) Instead, we use an adjusted Herfindahl-Hirschman index to measure revenue diversification. Various authors have applied a similar measuring method (see, e.g., Acharya et al. 2002; Stiroh & Rumble 2003; Stiroh 2004). Equation below shows how this study constructed the

diversification index.

$$HHI_i = 1 - \left(\left(\frac{INT}{TOR} \right)^2 + \left(\frac{COM}{TOR} \right)^2 + \left(\frac{TRAD}{TOR} \right)^2 + \left(\frac{OTI}{TOR} \right)^2 \right)$$

The variable definitions are as follows: INT denotes gross interest revenue, COM denotes net commission revenue, TRAD denotes net trading revenue, OTI denotes all other net revenue and TOR denotes total operating revenue. Denominator TOR is equal to the sum of the absolute values of INT, COM, TRAD and OTI, and we use gross interest revenue so that our diversification measure is not unduly distorted by the profitability of the bank's interest business. We use accounting data from the TEJ database which consistently reports gross numbers for the other revenue categories.

We subtract the sum of squared revenue shares from unity so that HHI increases in the degree of revenue diversification, the higher values of HHI, mentioning the degree of diversification is much higher. By definition HHI can take on values between zero (the bank and credit union is fully specialized in only one business areas) and 0.75 (the bank and credit union generates a fully balanced revenue mix from all four business areas).

(2) Non-interest income to operating income ratio (DIV_{NIOIR})

This is a simple way to measure the degree of diversification that banks and credit unions take. Adopting this ratio basically let us see through the characteristics of bank and credit union industry. Banks and credit unions are the intermediate organizations that bring money borrowers and lenders together. So the traditional income sources of these two financial corporations are the interest income. When banks and credit unions do more non-interest activities, they will have more non-interest income. The equation of calculating the Non-interest income to total income ratio is as follows:

$$DIV_{NIOIR} = \frac{Operating\,Income - Interest\,Income}{Operating\,Income}$$

Operating income of banks and credit unions can easily separate into two major elements: interest income and non interesting income. When non-interest income arises, that means this organization take more actions on diversification.

Other Variables

We put ten variables in our panel threshold regression model in order to analyze the relationship between other variables and the dependent variables. Those variables are collected from the annual financial reports of banks and credit unions in Taiwan. And the ten other variables are: overdue loan rate(OLR), liability to net value ratio(LN), loan growth

ratio(LGR), operating expense to operating income ratio(EIR), equity to asset ratio(EAR), branch number(BN), asset scale(AS), allowance for uncollectible accounts to overdue loan ratio(AOR), capital ratio(CR), and loan ratio(LR).

Empirical Model

When defined all of the variables, we construct the panel threshold regression model as bellow equation:

$$ROE_{it} = \mu_i + \beta_1 DIV_{it-1} I(DIV_{it-1} \le \gamma_1) + \beta_2 DIV_{it-1} I(DIV_{it-1} > \gamma_1) + \theta_1 OLR_{it-1} + \theta_2 LNR_{it-1} + \theta_3 LGR_{it-1} + \theta_4 EIR_{it-1} + \theta_5 LR_{it-1} + e_{it-1} \quad (2.9)$$

$$Z_{it} = \mu_i + \beta_3 DIV_{it-1} I(DIV_{it-1} \le \gamma_2) + \beta_4 DIV_{it-1} I(DIV_{it-1} > \gamma_2) + \theta_6 BN_{it-1} + \theta_7 AS_{it-1} + \theta_8 OLR_{it-1} + \theta_9 LNR_{it-1} + \theta_{10} AOR_{it-1} + \theta_{11} CR_{it-1} + e_{it-1} \quad (2.10)$$

The DIV variable here can be DIV_{HHI} and DIV_{NIOIR} respectively. When the primary models are constructed, we use GAUSS program and use the bootstrap 300 times, in order to get the F-Statistics and p-value. If the p-value is less than 5%, we continue to do the double threshold test. The models are as follows:

$$ROE_{it} = \mu_i + \beta_1 DIV_{it-1} I(DIV_{it-1} \le \gamma_1) + \beta_2 DIV_{it-1} I(\gamma_1 < DIV_{it-1} \le \gamma_3) + \beta_3 DIV_{it-1} I(\gamma_3 < DIV_{it-1}) + \theta_1 OLR_{it-1} + \theta_2 LNR_{it-1} + \theta_3 LGR_{it-1} + \theta_4 EIR_{it-1} + \theta_5 LR_{it-1} + e_{it-1} \quad (2.11)$$

$$Z_{it} = \mu_i + \beta_3 DIV_{it-1} I(DIV_{it-1} \le \gamma_2) + \beta_4 DIV_{it-1} I(\gamma_2 < DIV_{it-1} \le \gamma_4) + \beta_3 DIV_{it-1} I(\gamma_4 < DIV_{it-1}) + \theta_6 BN_{it-1} + \theta_7 AS_{it-1} + \theta_8 OLR_{it-1} + \theta_9 LNR_{it-1} + \theta_{10} AOR_{it-1} + \theta_{11} CR_{it-1} + e_{it-1} \quad (2.12)$$

EMPIRICAL RESULTS

We must examine the number of threshold for equation (2.9) and (2.10) to check if banks and credit unions do diversification could bring what influence to their financial performances and risks. If the single threshold effect exists, we continue to examine equation (2.11) and (2.12) to find the double threshold effect. We have two dependent variables-RAR_{ROE}, Z-score; two diversification variables-DIV_{HHI}, DIV_{NIOIR}. So there will be four threshold testing combinations: (1) RAR_{ROE}, DIV_{HHI}; (2) RAR_{ROE}, DIV_{NIOIR}; (3) Z-score, DIV_{HHI}; (4) Z-score, DIV_{NIOIR}.

Table 1, 2, 3, 4 show the results and the bootstrapped critical values for single, double, and triple threshold effects for the four threshold testing combinations respectively. Through 300

bootstrap replications for each of three bootstrap tests, we find the tests for single threshold F_1 almost all are significant with bootstrap p-value0.0200, 0.0133, 0.1400, and 0.0467. The tests for double threshold F_2 are all statistically significant with p-value of 0.0300, 0.004, 0.0033, and 0.0400. And the tests for a triple threshold F_3 are insignificant with p-value of 0.9033, 0.9267, 0.9667, and 0.9833. Statistics F_1 and F_2 exceed the critical values at the 5% significant level, but is smaller than the critical value at the 10% significant level.

Table 1

Tests for Threshold Effects- RAR_{ROE}, DIV_{HHI}

Test for Single Threshold	
F_1	18.938326
P-Value	0.0200**
(10%, 5%, 1% critical values)	(13.018432, 15.528865, 20.245525)
Test for Double Threshold	
F_2	19.997362
P-Value	0.0300**
(10%, 5%, 1% critical values)	(13.433144, 16.094187, 23.642480)
Test for Triple Threshold	
F_3	3.3939502
P-Value	0.9033
(10%, 5%, 1% critical values)	(13.799717, 18.517817, 29.689262)

Note: ** indicates statistical significance at 5%.

Table 2

Tests for Threshold Effects- RAR_{ROE}, DIV_{NIOIR}

Test for Single Threshold	
F_1	22.980451
P-Value	0.0133**
(10%, 5%, 1% critical values)	(13.133243, 15.875910, 23.559242)
Test for Double Threshold	
F_2	16.041866
P-Value	0.004**
(10%, 5%, 1% critical values)	(13.233615, 15.187974, 21.847831)
Test for Triple Threshold	
F_3	3.2433529
P-Value	0.9267
(10%, 5%, 1% critical values)	(11.968392, 14.503536, 23.954398)

Note: ** indicates statistical significance at 5%.

Table 3

Tests for Threshold Effects- Z-score, DIV_{HHI}

Test for Single Threshold	
F_1	11.064261
P-Value	0.1400
(10%, 5%, 1% critical values)	(12.302305, 14.912992, 19.911903)
Test for Double Threshold	
F_2	18.679722
P-Value	0.0033**
(10%, 5%, 1% critical values)	(12.123252, 14.314477, 16.311188)
Test for Triple Threshold	
F_3	2.7724506
P-Value	0.9667
(10%, 5%, 1% critical values)	(14.824632, 22.450637, 45.231634)

Note: ** indicates statistical significance at 5%.

Table 4

Tests for Threshold Effects- Z-score, DIV_{NIOIR}

Test for Single Threshold	
F_1	14.027480
P-Value	0.0467**
(10%, 5%, 1% critical values)	(11.695873, 13.624405, 19.460986)
Test for Double Threshold	
F_2	14.400398
P-Value	0.0400**
(10%, 5%, 1% critical values)	(12.154482, 13.843604, 17.382107)
Test for Triple Threshold	
F_3	2.3471374
P-Value	0.9833
(10%, 5%, 1% critical values)	(12.443612, 15.572665, 21.282345)

Note: ** indicates statistical significance at 5%.

As can be seen, the threshold model (2.9) and (2.10) have three regimes, suggesting the possibility of two thresholds. We next examine the threshold values after confirming the threshold effect. Table 5, 6, 7, and 8 show the estimated two threshold values for the four threshold testing combinations respectively. These minor confidence intervals show the efficiency of estimation. Hence, there are three regimes in this case. These three regimes are

referred to as low, middle, and high if their DIV_{HHI} or DIV_{NIOIR} fall below γ_1, within the ranges γ_1-γ_2, and exceed γ_2, respectively. These show the location of the threshold values and their 95% confidence interval by computing the LR test mentioned above. According to the threshold test results our double threshold regression model from the model can be expressed as model (2.11) and (2.12).

Table 5

Threshold Estimates- RAR_{ROE}, DIV_{HHI}

γ_1		γ_2
0.40432900		0.37980523
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.37980523	> 0.37980523; < 0.40432900	> 0.40432900

Table 6

Threshold Estimates- RAR_{ROE}, DIV_{NIOIR}

γ_1		γ_2
0.25485232		0.28128672
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.25485232	> 0.25485232; < 0.28128672	> 0.28128672

Table 7

Threshold Estimates- Z-score, DIV_{HHI}

γ_1		γ_2
0.37955960		0.40432900
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.37955960	> 0.37955960; < 0.40432900	> 0.40432900

Table 8

Threshold Estimates- Z-score, DIV_{NIOIR}

γ_1		γ_2
0.25460196		0.28128672
Low (Regime 1)	**Middle (Regime 2)**	**High (Regime 3)**
< 0.25460196	> 0.25460196; < 0.28128672	> 0.28128672

CONCLUSION

Within this study, we can learn the trend of diversification of banks and credit unions

throughout the years, both of these two types of financial organizations enhance their degree of diversification. That means they do more non-interest income activities to earn more of their operating income. That is why the two diversification ratios, DIV_{HHI} and DIV_{NIOIR}, are increasing.

The panel threshold regression model can find the relationships of variables under different regimes and efficiently estimate results powerfully, by using the bootstrapping technique. After running the Panel Threshold Regression Model, we can clearly know when banks and credit unions in Taiwan do diversification, then that would definitely influence their financial performance and risk. Here we use RAR_{ROE} to be the performance variable and Z-score, risk variable. Because the single and double threshold tests are both significant, there are three regimes of banks and credit unions' diversification level. Under certain level, that would come out different influence to their financial performance and insolvent risk. So making decisions of doing diversifications becomes a very important idea for management of banks and credit unions.

The findings can help researchers to understand that different types of financial institutions may optimally choose different degrees of diversification, which sheds some light on the inconsistent findings in the literature regarding the relationship between diversification and firm values. And for banks and credit unions, they can evaluate their conditions to meet the exact one in our research, then, decide what degree of diversification they can do to enhance their performance and reduce risks.

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Off-balance Sheet Activities and Bank Efficiencies: The Three-Stage Data Envelopment Analysis with Undesirable Outputs

Chuang-Min Chao, National Taipei University of Technology, Taiwan
Tsui-Chu Chang, National Taipei University of Technology, Taiwan
tsuichu@hotmail.com

ABSTRACT

This study evaluates bank efficiencies in Taiwan using the three-stage DEA proposed by Fried, Lovell, Schmidt and Yaisawarng(2002), and accounts for the impact of the OBS activities on bank efficiencies. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies. The data consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan. The results demonstrated that the main influence of environmental factors on efficiency is macroeconomic variables. Besides, after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

Keywords: Efficiency, Off-balance sheet activities, Three-stage data envelopment analysis, Undesirable output

INTRODUCTION

In recent years, the financial deregulation and innovation have changed the product mix of banks. Banks are active in developing new forms of financial products like the off-balance sheet (OBS) activities. During 2002 to 2007, the nominal value of the OBS activities expanded rapidly in Taiwan, with an increase of nearly 246%. As a result, the non-interest income, of which a large portion is from the fee-based the OBS activities, has increased from 16% in 2002 to 22% of the total income in 2007(Table 1). It indicates that the OBS activities play an important role in the banking operations. Thus, it is important to include these activities in the evaluation of the bank efficiencies.

Previous researches regarding the evaluation of the bank efficiencies seldom take the OBS activities into account. Recent studies using data envelopment analysis (DEA) or stochastic

Table 1

The nominal value of the OBS activities and the ratio of non-interest income to total income

Year	The nominal value of the OBS activities	The ration of non-interest income to total income (%)
2002	2,939,564	16.15%
2003	3,663,615	23.86%
2004	6,259,222	26.43%
2005	6,623,675	22.76%
2006	8,910,494	19.36%
2007	10,183,951	22.41%

Notes: The nominal value of the OBS activities are the aggregate of loan commitments, guarantees, letter of credit issued, and liabilities trusted. The unit of the OBS activities are in NT$ million.

frontier approaches (SFA) begin to include either non-interest income (Roger, 1998; Drake, 2001; Tortosa-Ausina, 2003) or the OBS items (Isik and Hassan, 2003; Casu and Girardone, 2005; Liu, Yeh, and Chiu, 2005) as additional output factors. Additionally, other studies(Clark and Siems, 2002; Isik and Hassan, 2003; Liu, et al., 2005) argue that omitting the OBS activities in the estimation of bank efficiencies may result in under-estimating the actual bank outputs, which may lead to biased conclusions. Therefore, this study is going to take the OBS activities into account when evaluating the efficiency of banks.

The purpose of this study is to evaluate bank efficiencies in Taiwan using the three-stage DEA proposed by Fried, Lovell, Schmidt and Yaisawarng(2002), and to account for the impact of the OBS activities on bank efficiencies. The OBS activities, such as the fee-based services, guarantees, commitments, and derivative securities, can earn the non-interest income for banks on the one hand, but may increase the operational risk on the other hand. Banks want to make more profit but to avoid risks. Therefore, we divide the outputs into the desirable outputs and the undesirable outputs. The revenue contribution of the OBS activities is defined as the desirable output, which is proxied by the non-interest income. While the risk side of the OBS activities is defined as the undesirable output, which is proxied by the nominal value of the OBS activities. Additionally, a lot of researches relating to the efficiency of financial institutions (Chang, 1999; Park and Weber, 2006; Chen, Yu, Chang, and Hsu, 2007) treat non-performing loans as the undesirable output. Non-performing loans are an undesirable by-product of the loan production process, and they are unavoidable. Thus, non-performing loans are also the undesirable output in this study.

The contribution of this study is as follows. First, no previous researches have divided the OBS activities into desirable output and undesirable output. Second, according to the literature of the three-stage DEA, no one use the slack-based DEA with undesirable outputs in the first and third stage of the three-stage DEA. In this study, the three-stage DEA is applied to purge the environmental factors and statistical noise, and this study also divides the OBS activities into the desirable output and undesirable output.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature. Section 3 outlines the methodology of the three-stage DEA, and introduces the model this study used. Section 4 presents data and variables. Section 5 discusses the empirical results, and Section 6 concludes the study.

LITERATURE REVIEW

The impact of the OBS activities on the bank efficiencies

The OBS activities, such as the fee-based services, guarantees, commitments, and derivative securities, are contingent assets and liabilities, which remain only in the notes to financial statements. Although the OBS activities are not make into a list of balance sheet, they will influence the cash flows of banks in the future. Therefore, recent studies think the OBS activities should be took into account when evaluating the efficiency of banks.

Clark and Siems (2002) employ the distribution free and stochastic frontier estimation methods to derive the cost and profit X-efficiency of banks, and investigate the impact of the OBS activities on the measurement of X-efficiency. They also examine the relationship between X-efficiency scores, bank size, and the composition of the OBS activities. The results indicate that the estimation of economic cost and production cost X-efficiency increase with the inclusion of the OBS measure, whereas the estimation of profit X-efficiency is largely unaffected. Further, the OBS activities can help to explain the differences between banks in the evaluation of cost and profit X-efficiency.

Isik and Hassan(2003) utilize DEA to measure Turkish bank' efficiencies fist, and then employ the Malmquist total factor productivity change index to examine productivity growth, efficiency change, and technical progress in Turkish commercial banks during the deregulation of financial markets in Turkey. They also investigate the influence of omitting the OBS activities on the efficiency of banks. The results show that the financial deregulation indeed improves the performance of Turkish banks, and productivity growth is mainly driven by efficiency increases rather than technical progress. The results also point out that

exclusion of the OBS activities may lead to biased conclusions, especially against the banks that are active in these non-traditional activities.

Liu, et al. (2005) adopt the stochastic cost frontier method to explore the impact of the OBS activities on the efficiency of Taiwan's banks during 1998 to 2001, and compare the cost inefficiency with or without the OBS activities. The results suggest that omitting the OBS activities result in under-estimating the cost efficiency. In addition, large banks have higher cost efficiencies, and have an ability to develop the OBS activities.

Casu and Girardone (2005) employ Malquist total factor productivity index to inspect the influence of the OBS activities in the definition of output on European banks' productivity. The results demonstrate that inclusion of the OBS activities increases the estimated productivity, and exclusion of the OBS activities may lead to under-estimate the productivity.

Pasiouras (2007) adopts DEA to estimate the efficiency of Greek commercial banks in the period of 2000 to 2004, and considers the effect of credit risk and the OBS activities. The loan loss provisions are as an extra input item to represent the credit risk of banks, and the OBS activities are as an additional output to explain the fact that banks are active in these non-traditional activities recently. This research also investigates the determinants of efficiency utilizing Tobit regression analysis. The results indicate that the loan loss provisions as an input increases the efficiency scores, but the OBS activities as an output do not have a significant impact. Additionally, capitalization, loan activity, market power and the number of branches have a positive and significant impact on efficiency.

To summarize, most of the studies investigates the impact of the OBS activities on banks' efficiency by adopting DEA or SFA. However, no previous researches have divided the OBS activities into the desirable output and the undesirable output. Therefore, this study divides the OBS activities into the desirable output and the undesirable output. The revenue contribution of the OBS activities is defined as the desirable output, which is proxied by the non-interest income. While the risk side of the OBS activities is defined as the undesirable output, which is proxied by the nominal value of the OBS activities.

The efficiency of financial institutions with the undesirable output

In the estimation of producers' performances, the earliest study which take undesirable outputs into account is Pittman (1983), and then Färe, Grosskopf, Lovell and Pasurka (1989) develop a non-linear DEA program to handle the situation that the desirable outputs are increased and the undesirable outputs are decreased.

Chang (1999) utilizes a non-parametric approach to incorporate risk into the measurement of technical efficiencies of the major financial intermediaries in rural Taiwan, and analyzes the relationship between risk and efficiency. Risk indicators are treated as undesirable outputs, including non-performing loans, allowance for loan losses, and risky assets. The results suggest that incorporating risk as an undesirable output has significant impact on the efficiency of credit departments of farmers' associations.

Park and Webber (2006) use directional technology distance function of 1992 to 2002, and the non-performing loans are treated as undesirable output. The results show that Korean banking industry experiences productivity growth which is mainly due to the fact that technical progress is more than enough to offset efficiency declines.

To summarize, in the study of evaluating the efficiency of financial institutions with the undesirable output, most studies treat non-performing loans as the undesirable output. Non-performing loans are an undesirable by-product of the loan production process, and they are unavoidable. However, no studies examine the effect of the OBS activities on the efficiency of financial institutions. Thus, non-performing loans and the risk side of the OBS activities are treated as the undesirable outputs in this study.

Three-stage DEA is used in estimation of financial institutions' efficiencies

Three-stage DEA is proposed by Fried, et al. (2002). They think the performance of producers is influenced by the environmental factors, managerial inefficiency, and statistical noise. Thus, in order to get the correct efficiency scores and ranking, the managerial inefficiency should be isolated from environmental factors and statistical noise.

Pastor (2002) adopts three-stage DEA to obtain the measurements of efficiency adjusted for risk and environment, and decomposes the bad loan into its two components: one part is caused by the bad risk management and another is caused by exogenous economic and environmental factors. The results suggest that about 80% of bad loan is due to internal factors of firms, while the rest is due to exogenous conditions of firms.

Drake, Hall, and Simper (2006) evaluate the technical efficiency of Hong Kong financial institutions during the period of 1995 to 2001 by using three-stage DEA. The results indicate that the Hong Kong banking industry is indeed affected by external factors, like macroeconomic and housing market factors.

Chen, Yu, Chang, and Hsu (2007) extend three-stage DEA proposed by Fried, et al. (2002) to

improve the measurement of productivity growth. The directional distance function with undesirable output is used in the first stage, and non-performing loans are treated as the undesirable output. In the second stage, SFA is adopted to regress the estimated output slacks against the environmental variables. After eliminating the influence of environmental factors and statistical noise, the Malmquist-Luenberger productivity index is applied to measure the productivity growth.

Chiu and Chen (2008) employ the three-stage DEA to estimate the efficiency of 29 banks in Taiwan during the period of 2002 to 2004. In the first stage, super slacks-based measure (SBM) is used to obtain the initial efficiency scores. SFA is then adopted to estimate the external environment risk effects in the second stage. Finally, in the third stage, they reuse the SBM model again to evaluate the efficiency which eliminates the effect of environmental factors. The results show that external environmental variables do influence the efficiency of domestic banks.

To sum up, in the previous studies of measuring the efficiency of the financial institutions by using the three-stage DEA, only Chen, et al. (2007) account for the undesirable output in their three-stage DEA model. Nevertheless, the model they used is the directional function with the undesirable output, while the model we used in the first and third stage is slack-based measure (SBM) with undesirable outputs proposed by Cooper, Seiford, and Tone (2007).

METHODOLOGY

The three stage DEA is employed to measure the efficiency of banks in Taiwan. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. The goal is to purge the influence of environmental variables and statistical noise on the input and output slacks. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies.

In the first stage of the three-stage DEA

The model we used is proposed by Cooper, et al. (2007). They modify the slack-based measure (SBM) model proposed by Tone (2001) so as to account for the undesirable outputs.

$$\rho^* = \min \frac{1 - \frac{1}{m}\sum_{i=1}^{m} \frac{s_{io}^-}{x_{io}}}{1 + \frac{1}{s}\left[\sum_{r=1}^{s_1} \frac{s_r^g}{y_{ro}^g} + \sum_{r=1}^{s_2} \frac{s_r^b}{y_{ro}^b}\right]}$$

subject to

$$\begin{aligned} x_o &= X\lambda + s^- \\ y_o^g &= Y^g\lambda - s^g \\ y_o^b &= Y^b\lambda + s^b \\ L &\le e\lambda \le U \\ s^-, s^g, s^b, \lambda &\ge 0 \end{aligned} \tag{1}$$

Where λ is the intensity vector, and L and U are the lower and upper bounds of the intensity vector, respectively. The output matrix Y is decomposed into (Y^g, Y^b) where Y^g and Y^b denote good (desirable) and bad (undesirable) output matrices, respectively. The vector s^- and s^b correspond to excess in inputs and bad outputs, respectively, while s^g expresses shortage in good outputs.

In the second stage of the three-stage DEA

The dependent variable is the input and output slack obtained from the first stage, and the objective of this stage is to eliminate the influence of environmental variables and statistical noise on the input and output slacks.

$$\begin{aligned} S_{ij} &= f^i(Z_j;\beta^i) + v_{ij} + u_{ij} \\ S_{rj} &= f^r(Z_j;\beta^r) + v_{rj} + u_{rj} \\ i &= 1,2,...,m;\ r = 1,2,...,s;\ j = 1,2,...,n \end{aligned} \tag{2}$$

Where S_{ij} and S_{rj} are the *j*-th firm of *i*-th input and output slack, respectively. Z_j is the *k*-th environmental factors of the *j*-th firm, and β^i and β^r represent the estimated parameters. The v_{ij} and v_{rj} are error term which assume $v_{ij}, v_{rj} \sim N(0, \sigma_v^2)$, and independent of the u_{ij} and u_{rj} where they are nonnegative random variables accounting for managerial inefficiency which assume $u_{ij,}\, u_{rj} \sim N^+(u\ , \sigma_u^2)$.

$$X_{ij}^A = X_{ij} + [\max_j\{z_j\hat{\beta}^i\} - z_j\hat{\beta}^i] + [\max_j\{\hat{v}_{ij}\} - \hat{v}_{ij}] \tag{3}$$

$$Y_{rj}^{g,A} = Y_{rj}^g + [z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}] + [\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}] \tag{4}$$

$$Y_{rj}^{b,A} = Y_{rj}^{b} - [z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}] - [\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}] \quad (5)$$

After regressing against a set of environmental variables, the initial input and output have to be adjusted. The equation (3), (4), and (5) are used to adjust for the environmental effects and statistical noise. Where X_{ij}, Y_{rj}^{g}, and Y_{rj}^{b} are the initial input, desirable output and undesirable output, respectively. X_{ij}^{A}, $Y_{rj}^{g,A}$, and $Y_{rj}^{b,A}$ denote the adjusted input, desirable output, and undesirable output, respectively. The equation of $[\max_j\{z_j\hat{\beta}^i\} - z_j\hat{\beta}^i]$ and $[z_j\hat{\beta}^r - \min_j\{z_j\hat{\beta}^r\}]$ are in order to let producers in the same operating environment, and the equation of $[\max_j\{\hat{v}_{ij}\} - \hat{v}_{ij}]$ and $[\hat{v}_{rj} - \min_j\{\hat{v}_{rj}\}]$ are in order to let producers in the condition where is not affected by statistical noise.

In the third stage of the three-stage DEA

Stage 3 is a repetition of stage 1, with observed input (X_{ij}), desirable output (Y_{rj}^{g}), and undesirable output (Y_{rj}^{b}) replaced with adjusted input (X_{ij}^{A}), desirable output ($Y_{rj}^{g,A}$), and undesirable output ($Y_{rj}^{b,A}$), respectively. The input and output of this stage is eliminated from the effect of environmental factors and statistical noise, so the efficiency scores this stage obtained is got rid of the influence of the environmental factors and statistical noise.

EMPIRICAL RESULTS

DATA AND VARIABLES

The data used in this study consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan. There are three inputs and five outputs. The input factors are interest expense and non-interest expense. The output factors include three desirable outputs (i.e., non-interest income, deposits and total loans) and two undesirable outputs (i.e., the nominal value of the OBS activities and the non-performing loans). Moreover, five environmental variables are employed in the second stage of the three-stage DEA, including the number of years that the bank has been operating, branches in city, economic growth rate, growth rate of money supply and unemployment rate. Drake, et al.(2006) point out that the primary external influence on efficiency in the Hong Kong banking industry is the macroeconomic cycle. Thus, we choose three macroeconomic variables in this study. Table 2 shows the description of variables.

In the first stage, initial input and output should be used to calculate the initial efficiency scores. Table 3 shows the summary statistics of efficiency scores in the fist stage for the period from 2005 to 2007. The efficiency scores obtained from the first stage is not adjusted

Table 2

The description of variables

Symbol	Variable	Definition	Unit
Inputs			
X1	Non-interest expense(NIE)	Operating cost–interest expense	NT$ hundred millions
X2	Interest expense(IE)		NT$ hundred millions
Desirable outputs			
Y1	Non-interest income(NII)	Operating revenue–interest income	NT$ hundred millions
Y2	Deposits(DE)	Checking deposit, demand deposit, time deposit, and negotiable certificates of deposit	NT$ hundred millions
Y3	Total loans(TL)	Short-term loans and long-term loans	NT$ hundred millions
Undesirable outputs			
B1	The nominal value of the OBS activities(OBS)	loan commitments, guarantees, letter of credit issued, and liabilities trusted	NT$ hundred millions
B2	Non-performing loans(NPL)		NT$ hundred millions
Environmental variables			
Z1	the number of years that the bank has been operating (YEAR)	The number of years that the bank was established to the end of 2007	
Z2	branches in city (CITYBR)	The number of branches in Taipei and Kaohsiung in Taiwan.	
Z3	economic growth rate (EGR)		%
Z4	growth rate of money supply(M2)		%
Z5	unemployment rate (UR)		%

by the environmental factors and statistical noise. The average of efficiency scores in 2005, 2006, and 2007 are 0.747, 0.61, and 0.572, respectively. The standard deviations of efficiency scores in 2005, 2006, and 2007 are 0.285, 0.352, and 0.371, respectively.

In the second stage, input and output slacks should regress against a set of environmental variables. Table 4 shows the stochastic frontier estimation results in the second stage. The number of years that the bank has been operating has a negative and significant impact on the non-interest expense slacks and the total loan slacks. The branches in city is significantly and

Table 3
Summary statistics of efficiency scores in the first stage, 2005-2007

Year	2005	2006	2007
No. of DMUs	36	36	36
Average	0.747454581	0.6101759	0.5716803
SD	0.28479596	0.3519829	0.3710175
Maximum	1	1	1
Minimum	0.174433472	0.0687324	0.0424925

positively related to the non-interest expense slack, the interest expense slack, the non-interest income slack, and the total loan slack. The economic growth rate has a significant and positive impact on the non-interest expense slack, non-interest income slack, total loan slack, and non-performing loan slack, but has a significant and negative impact on the interest expense slack, the deposits slack, and the nominal value of OBS activities slack. The money supply rate has significant and positive relation to the most slacks, but has significant and negative relation to the deposits slack and the nominal value of OBS activities slack. The unemployment rate is significantly and negatively related to the most slacks, but significantly and positively related to the nominal value of OBS activities slack and deposits

Table 4
Second stage–stochastic frontier estimation results

Independent variable	Dependent variables						
	NIE slack	IE slack	NII slack	DE slack	TL slack	OBS slack	NPL slack
Constant	–147.04**	5.25**	–374.32**	120.98**	–979.09**	–356.61**	–200.06**
	(2.60)	(1.32)	(5.17)	(2.07)	(5.03)	(33.26)	(1.09)
YEAR	–0.59*	–0.12	–0.08	–0.65	–2.80*	–2.57	0.27
	(0.42)	(0.12)	(0.8)	(1.4)	(2.11)	(6.05)	(0.49)
CITYBR	0.46*	0.22**	1.64**	–0.30	3.67**	6.34	–0.17
	(0.36)	(0.1)	(0.65)	(1.14)	(1.82)	(5.6)	(0.46)
EGR	87.29**	–9.22 *	162.7**	–66.13**	638.57**	–534.29**	86.62**
	(20.29)	(7.14)	(42.42)	(11.34)	(53.07)	(274.57)	(4.32)

Independent variable	Dependent variables						
	NIE slack	IE slack	NII slack	DE slack	TL slack	OBS slack	NPL slack
M2	22.60**	–1.07	44.06**	–47.67**	191.26**	–125.12*	25.34**
	(5.99)	(2.48)	(12.86)	(8.4)	(13.43)	(86.46)	(3.08)
UR	–94.45**	9.98	–165.38**	84.31**	–741.99**	799.54**	–89.59**
	(30.13)	(10.82)	(63.28)	(11.38)	(66.9)	(412.07)	(4.01)

Notes: *Significant at the 10% level. **Significant at the 5% level. The standard deviations are in parenthesis.

Table 5
Comparison of stage 1 and stage 2

	The first stage	The Third stage
Mean	0.6431	0.7775
Std. Deviation	0.3479	0.2212
Minimum	0.0425	0.3586
Maximum	1	1
Wilcoxon Signed Ranks Test	-3.446(0.001)**	

Notes: **Significant at the 5% level. P-value is in parenthesis.

slack. The results also indicate that the main influence of environmental factors on efficiency is macroeconomic variable, and this is consistent with Drake, et al. (2006).

After regressing the input and output slacks against the environmental variables, the input and output are adjusted for the influence of environmental variables and statistical noise. The efficiency obtain from the third stage is eliminated from environmental variables and statistical noise. Table 5 shows the comparison of stage 1 and stage 3. After adjusting for the influence of environmental factors and statistical noise, the mean efficiency scores increase. This study utilizes Wilcoxon signed ranks test to investigate the differences between the stage 1 and the stage 3, and the results is also presented in Table 5. According to the Table 5, it is found that there is a significant difference between efficiency scores of the first stage and the third stage under the significant level of 0.05. It means that after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

CONCLUSION

In this article, we use three-stage DEA propose by Fried, et al. (2002) to measure the efficiency of banks in Taiwan, and account for the impact of the OBS activities on bank efficiencies. In the first stage, the slack-based DEA with undesirable outputs is applied to obtain the initial efficiency. In the second stage, the stochastic frontier approach is used and the stage 1 slacks are regressed against a set of environmental variables and statistical noise. In the third stage, the inputs and outputs are adjusted to account for the environmental effects and the statistical noise identified in the second stage, and the stage 1 model is used again to re-evaluate bank efficiencies. The data consists of 36 banks for the three-year period from 2005 to 2007 in Taiwan.

The results demonstrated that the main influence of environmental factors on efficiency is macroeconomic variable. Besides, after purging the environmental effects and statistic noise, the efficiency of banks in the third stage is significantly greater than in the first stage.

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A STUDYING OF MEASURING THE E-SERVICE QUALITY OF ONLINE HUMAN RESOURCE AGENCY

Qinan K. Y. Lin, Dr. Bruce C. T. Ho
Institute of electronic commerce, National Chung-Hsing University, Taiwan
Qinan624@gmail.com

ABSTRACT

Research Background –
The Internet has significantly expanded the definition of e-commerce. Recently, the development of online Human Resource (HR) agencies attracts extensive attention in Taiwan. Through still in the infancy, the usage of job searching shows great potential for improving the overall effectiveness of online HR agencies.

Research Purpose –
The age of e-commerce opens numerous possibilities that will extend the understanding of electronic service quality. Beginning in the 2000s, researchers studying service quality began to shift the primary focus of research from the physical dimensions of customer service to the virtual dimensions of electronic service. This paper aims to develop a scale that could be used to measure the service quality of online HR agency and to understand the underlying service quality dimensions.

Design/Methodology/Approach –
The main data collection instrument used in this study was questionnaire. A survey based on website was conducted to test our model. The data was collected from users of online HR websites in Taiwan. The questionnaire extended items to assess the service quality of online HR agency by referring to the e-service quality scale and modified its items. The questionnaire comprises two sections. The first section gathers information from the users' perception of the service quality of online HR agency services. The second section collects information including the respondents' gender, age, education, occupation, time spent online, and frequency of using online HR agency.

Findings/Results –
Within the internet environment, service quality dimensions are different from the physical environment. Therefore, we adapted an e-service quality model in this study as the foundation. Such a theory is only the starting point, requiring explanation in terms of cause and effect. In this paper, we validated that online HR agency can be analyzed by a five-dimension service quality constructs involve efficiency, system availability, privacy, personalization, and responsiveness. These research results underscore the importance of electronic service quality.

Originality/value–
In the last decade of electronic commerce development, we have seen mounting evidence of the usefulness of website designers' incorporating strategies into their website building process. However, theories need to be tied to empirical operations and empirical data. In this paper, the service quality of the online HR agency in Taiwan was measured by an integrated framework. The method was proved more suitable than the previous studies that based on the traditional service quality model. Such an examination may lead to a better understanding of variables that affect CRM performance.

Keywords: e-service quality, online HR agency, B2C website

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THE EFFECTS OF PROJECT'S SOCIAL CAPITAL, LEADERSHIP STYLE, MODULARITY, AND DIVERSIFICATION ON NEW PRODUCT DEVELOPMENT PERFORMANCE

Dr. Li-Yueh Lee, Kun Shan University, Taiwan
wuleliyu@gmail.com
Ms. Shu-Min Li, Cheng Kung University, Taiwan
ra796402@mail.ncku.edu.tw
Mr. Shang-Min Chen, Cheng Kung University, Taiwan
stellaleejh@hotmail.com

ABSTRACT

Due to the rapid advanced information technology and the complicated business environment, firms are facing more and more competitive situations. To overcome this issue, companies try to create new products to stay competitive advantage. This study aims to explore the effects of projects' social capital, leadership style, modularity and diversification on new product development (NPD) performance. Therefore, the research objectives of this study are (1) to develop a comprehensive research framework to integrate the social capital, project leadership style, modularity, team member diversification, and NPD performance; (2) to identify the interrelationships between social capital, project leadership style, modularity level, and team member diversification on NPD performance; (3) to investigate the different level of social capital and project leadership style on NPD performance; and (4) to investigate the different level of modularity and team member diversification on NPD performance.

Using the 500 senior leaders of NPD teams from different manufacturing firms in Taiwan, this study concludes the following five conclusions, (1) higher level participating style of leadership and higher level of social capital generate better NPD performance, (2) higher level of selling leadership style and social capital create better NPD performance, (3) higher level of telling leadership style and social capital facilitate better performance in design change frequency and innovation, (4) higher level of delegating leadership style and social capital enhance better performance in product prototype development and launch proficiency, technological core competency, and innovation level, and (5) higher level of modular of new product leads to better NPD performance. Managerial implications are also illustrated.

Keywords: NPD performance, modularity, leadership style, social capital, project team diversity

RESEARCH BACKGROUND AND MOTIVATIONS

In the dynamic business environment, firm should efficiently innovate new product or new process to fit market demand. In many cases, new product is a direct result of firm innovation. Higgins (1995) contends that innovation will create extreme values towards the organizations and can be regarded as a secret weapon for firms to acquire competitive advantage. Although new product development (NPD) seems to be the only choice for firms to become competitive, it is a risky work. Cooper and Kleinschmidt (1987) estimate that failure rate of the new product is about 75%. Gallo (1992) further argues that, in the grocery industry, the

failure rate for new product is estimated to be 80 to 95 percent. Thus, the NPD process is difficult because there is less synergy between the needs of the project and the firm's existing skills and resource base. In addition, there is a high degree of uncertainty concerning customers' needs and competitor's actions.

In the process of creating new product, several key issues are essential. These include project leader's leadership styles and skills, organizational culture, team member readiness and experience in NPD, team's relationship with other units, etc. In addition, NPD team members with different backgrounds could agitate different idea and may consequently increase the probability of success. Furthermore, according Yli-Renko et al. (2001), social capital can accelerate the probability of NPD success through increasing the freedom of knowledge-sharing. It can agitate different ideas through members' interaction. Finally, as the needs for firms to be able to deliver high quality products at low cost has long been recognized, many companies have adopted modular architecture instead of integrated architecture to achieve rapidly response. The needs of consumer have also become more diversity. New product adopts modular architecture which component could partial upgrade, maintain, repair, and disposal to exchange different function and form for diversity needs (Nevins and Whitney,1989).

Although there are plenty of studies argues for the importance of project leadership, social capital, modularity, and team member diversities for NPD performance. However, none of these studies have tried to integrate these variables together and identified the interaction effects of these variables on NPD performance. Based upon the above research background and motivations, the research objectives of this study are to firstly develop a comprehensive research framework to integrate the influences of social capital, project leadership style, modularity levels, and team member diversity on NPD performance. This study also aims to test the research framework through empirical data.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The Influences of Social Capital and Project Leadership Styles on NPD Performance

According to Bardach (2001), "Leadership is a means for diagnosing and implementing improvements in the operating subsystem of the Inter-organizational collaborative capacity, inducing resource contribution, nurturing an ethos of interpersonal trust and organizational pragmatism". Farris (1988) suggests that true leadership involves much more than effectively managing a group performing a task.

In the NPD team, leader is a key role in the team. He/she uses the knowledge, leadership, empathy, and ability to persuade followers to devote all themselves for achieving goals. Optimal leadership in a NPD team should not only encourage team members to work under diversity of member expertise, limited resources and time pressure but also have competences to handle both technical issues and behavior issues. Based on the above discussions, this study suggests that leadership style has a significant impact on NPD performance. The following hypothesis is proposed:

H1: Team leader's leadership style has significant effect on NPD performance.

Social capital is a set of social resources embedded in relationship (e.g., Burt, 1992; Loury, 1997). Some scholars have brought up social capital to facilitate inter-unit resource exchange, product innovation (Gabbay and Zuckerman, 1998; Hansen, 1999; Tsai and Ghoshal, 1998; Nahapiet and Ghoshal, 1998) and cross-functional team effectiveness (Rosenthal, 1996). This

study tries to view social capital from the perspectives of relational and informational flow. In the process of new product development, the project team requires a great deal of multiple information sources. Social interactions among team members who are strongly tied to each other are likely to develop a shared understanding of the utility of certain behavior. In a highly social capital environment, team members could share different knowledge, emotion, value, and information by formal or informal interaction. According to Laumann, Galaskiewicz, and Marsden (1978), network position is like a set of nodes (e.g., persons, organizations) linked by a set of social relationships (e.g., friendship, overlapping membership) of a specified type. If NPD project team stands on a core network position, this project team is able to interact with outsiders to get more information. In the process of new product development, the NPD team should integrate many factors such as different objects, knowledge, information, team member skills, etc. to create a successful new product. Based on the above discussion, the following hypothesis is developed:

H2: Social capital of the NPD team has significant effect on NPD performance

According to the contingency approach of leadership, an effective leadership style should be contingent upon several environmental factors. ……..???

H3: There is an interaction effect of project leadership style and social capital on NPD performance. NPD team having a higher transformational leadership approach and a higher level of social capital tends to achieve significantly higher NPD performance.

The Influences of Modularity Level and Team Member Diversity on NPD Performance

Modularity refers to "the degree to which a system's components can be separated and recombined" (Schilling, 2000). New products with higher levels of modularity mean that the component could independently operate without affecting others. Product modularity is the practice of using standardized product modules so they can be easily reassembled/ rearranged into different functional forms, or shared across different product lines. Since NPD project team needs to integrate many detailed processes to efficiently create value, it could be very complicate if the products need to be modified to fit the changes of customer needs. The change of one component or feature may require extensive redesign of the product. Therefore, the application of module concept can be very helpful to save a lot of cross functional communication, coordination and simplify the NPD process. Besides, product prototype uses modular design that taking individual blocks inlay in the new product will largely increase product variety for diversity consumer and can achieve economies of scale to reduce the cost of production. Based on these reasons, the following hypothesis is proposed:

H4: The levels of modularity that apply to the new product has significant effect on NPD performance

As mentioned earlier, information and knowledge are very important to promote new product development. In any NPD project, it needs multiple source of information to create value of the new product. NPD project member diversification will intensify different ideas, cognitions, and views to develop new product. Appropriate diversification is helpful for NPD team. In light of these reasons, the following hypothesis is proposed:

H5: Team member diversification has significant effect on NPD performance

As previous section, this study believes that team member diversification will accelerate modularity in NPD project because of multiple source of information or knowledge. This study believes that the interaction of team member diversification and the application of modularity will accelerate NPD performance. So, the following hypothesis is proposed:

H6: There is a significant interaction effect of NPD team member diversification and modularity on NPD performance.

RESEARCH DESIGN AND METHODOLOGY

Research Framework

Based on the above literature and hypothesis development, a research framework including five major constructs and their corresponding interrelationships is developed as shown in Figure 1. This research framework is used for further empirical validations in the later sections.

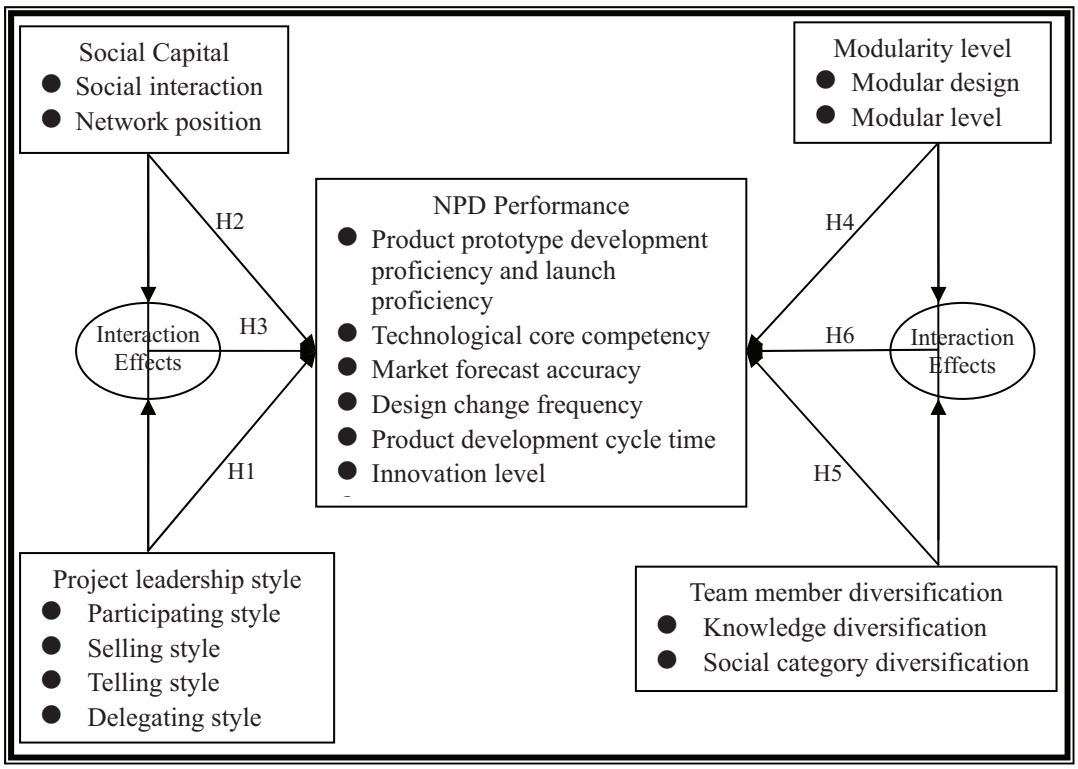

Figure 1 The Research Model

Questionnaire Design and Sampling Plan

There are five constructs to be measured in this study: (1) project leadership style; (2) social capital; (3) NPD performance; (4) modularity level; and (5) team member diversification. A preliminary version of this questionnaire is adopted from previous studies with some modifications based on the specific requirements of this study. Inter-judge reliability is conducted through the judges of one professor and two Ph.D. students major in marketing. Questionnaire items with low inter-judge reliability (i.e., item with two of the three judges disagree with the content) were deleted from the questionnaire items.

A sampling plan is developed to ensure that certain types of respondents are included in this study. This study selects 500 senior leaders of NPD teams from different manufacturing companies in Taiwan. The sampling frame is obtained from "The manager directory in Taiwan (2006)" published by *China Credit Information Service Inc.* As this study chooses senior NPD leaders who have participated in a successful NPD project, they are highly likely

to be the most knowledgeable about the topics in the questionnaire. The respondents are asked to express their perceptions on NPD performance, social capital, team member diversification, modularity level, and project leadership styles based on a specific NPD project that they participated. SPSS 13.0 is employed to analyze the data and to test the hypotheses.

RESULTS AND DISCUSSION

Descriptive Analysis

Descriptive analyses are conducted to provide information about the characteristics of respondents. Table 1 shows the basic attributes of the sample firms. These attributes includes five major items in the study: (1) industry, (2) history, (3) capital, (4) annual sales, and (5) number of employees.

Table 1 Characteristics of Sample Firms (n=95)

Industry					**History (year)**				
Information and Electrical Industry		Mechanical Industry	Chemical and Pharmaceutical Industry	Others	< 10	11 to 20	21 to 30	31 to 40	> 40
28		21	8	38	15	27	18	16	19
29.5%		22.1%	8.4%	40.0%	15.8%	28.4%	18.9%	16.8%	20.0%
Capital (million NTD)					**Annual Sales (million NTD)**				
< 80	81 to 200	201 to 500	501 to 1000	> 1000	< 100	101 to 500	501 to 1000	1000 to 10000	> 10000
14	10	18	16	37	10	17	14	34	20
14.7%	10.5%	18.9%	16.8%	38.9%	10.5%	17.9%	14.7%	35.8%	21.1%
Number of Employees									
< 500		501 to 1500	1501 to 3000		3001 to 5000		5001 to 10000	> 10000	
47		24	12		5		3	4	
49.5%		25.3%	12.6%		5.3%		3.2%	4.2%	

Reliability of the Research Construct
Interrelationships between Research Variables

Effect of Project Leadership Style on NPD Performance

According to Sherman, Berkowitz, and Souder (2005), NPD performance can be measured by product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time, and innovation level. Hersey, Blanchard, and Johnson (1996) suggest that project leadership style can be divided into participating, selling, telling, and delegating style. In order to test hypothesis 1, regressions with ordinary least squares (OLS) estimation method are employed on the full sample data. Table 2 presents the results of the regression using six factors of NPD performance as the dependent variables. The regression results suggest that, product prototype development (regression model M1-1) and launch proficiency is significantly influenced by participating style (β=0.388, $p<0.05$) and delegating type (β=0.166, $P<0.05$).

Table 2 Effect of Project Leadership Style on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M1-1	M1-2	M1-3	M1-4	M1-5	M1-6
Participating style (lsf1)	0.388***	0.3**	0.153	-0.165	.309**	0.166
Selling type (lsf2)	0.131	0.225*	0.180	0.069	0.054	0.071
Telling type (lsf3)	0.094	-0.089	-0.055	***-.404	0.075	.207**
Delegating type (lsf4)	0.166*	0.019	-0.019	0.066	0.030	0.075
R^2	0.289	0.251	0.099	0.165	0.126	0.098
Adj-R^2	0.258	0.217	0.059	0.128	0.087	0.058
F	9.163	7.527	2.462	4.443	3.230	2.452
D-W	2.111	2.117	1.485	1.874	1.781	2.015

In addition, technological core competency (regression model M1-2) is significantly influenced by participating style (β=0.300, P<0.01), and selling style (β=0.225, P<0.001,). The significantly positive coefficients indicate that the levels of participating style and selling style all contribute to the level of technological core competency. Furthermore, none of the independent variables has a significant influence on market forecast accuracy (regression model M1-3) as shown in Table 1. The design change frequency (regression model M1-4) is significantly influenced by telling style (β=-0.404, P<0.01). This result may suggest that a telling leadership approach will result in less design change frequency from product prototype development to volume production. The product development cycle time (regression model 1-5) is significantly influenced by participating style (β=0.309, P<0.01). The significantly positive coefficients indicate that the levels of participating leadership contributes to the level of product prototype development cycle time. Finally, innovation level (regression model M1-6) is significantly influenced by telling style M1-6 (β=0.207, P<0.05) The significantly positive coefficients indicate that the levels of telling style contribute to the innovation level. Based on these, hypothesis H1 is partial supported.

The Effects of Modularity Level on NPD Performance

Table 3 presents the effects of the modularity level on NPD performance, it is suggested that NPD performance is significantly influenced by modular design and modular level. The significantly positive regression coefficients indicate that degree of modular design and modular level can contribute to the factors of NPD performance. The results indicate that both modular design and modular level have significant influences on product prototype development and launch proficiency (β=0.226-0.229, p<0.05), and product development cycle time (β=o.211-0.260, p<0.05). Modular level is positively related to market forecast accuracy (β=0.186, p<0.05) and innovation level (β=0.239, p<0.05), but negatively related to design change frequency (β=-0.315, p<0.05). Therefore, hypothesis 4 is supported.

Table 3 The Effects of Modularity Level on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M2-1	M2-2	M2-3	M2-4	M2-5	M2-6
Modular design(mlf1)	.229**	.357***	0.176	0.050	.26**	-0.095
Modular level (mlf2)	.226**	-0.051	.186*	***-.315	.211**	.239**
R^2	0.145	0.116	0.092	0.090	0.155	0.048
Adj-R^2	0.126	0.096	0.072	0.070	0.137	0.028
F	7.774	6.015	4.649	4.522	8.442	2.339
D-W	2.048	1.886	1.600	1.657	1.930	1.905

Effect of Social Capital on NPD Performance

Table 4 presents the results of regressions of NPD performance, while using all six factors of NPD performance as the dependent variables. The results indicate that social interaction (scf1) is positively related to product prototype development and launch proficiency, technological core competency (β=0.387, $p<0.05$) and market forecast accuracy (β=0.368, $p<0.05$), while network position (scf2) is positively related to product prototype development and launch proficiency (β=0.312, $p<0.05$), product development cycle time (β=0.228, $p<0.05$) and innovation level (β=0.37, $p<0.05$), but negatively related to design change frequency (β=-0.368, $p<0.05$).

Table 4 Effect of Social Capital on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M3-1	M3-2	M3-3	M3-4	M3-5	M3-6
Social interaction (scf1)	.391***	.387***	0.368***	0.056	0.078	.182
Network position (scf2)	.312***	0.118	0.016	***-.368	.228**	.37***
R^2	0.366	0.207	0.141	0.119	0.075	0.234
Adj-R^2	0.352	0.190	0.123	0.100	0.055	0.217
F	26.509	12.018	7.511	6.205	3.734	14.052
D-W	2.238	1.928	0.151	1.749	1.673	2.175

Effect of Team Member Diversification on NPD Performance

Table 5 presents the influences of NPD team diversification on NPD performance. The results indicate that for all six regression models, both knowledge diversification and social category diversification do not have significant impacts on the factors of NPD performance, including product prototype development and launch proficiency, technological core competency, market forecast accuracy, design change frequency, product development cycle time and

innovation level. Since previous studies have shown a significant relationship between teams member diversifications and NPD performance, this issue may be subject to further validations.

Table 5 Effect of Team Member Diversification on NPD Performance

Dependent Variable / Independent Variable	Product prototype development and launch proficiency (npdf1)	Technological core competency (npdf2)	Market forecast accuracy (npdf3)	Design change frequency (npdf4)	Product development cycle time (npdf5)	Innovation level (inf)
	M4-1	M4-2	M4-3	M4-4	M4-5	M4-6
Knowledge diversification	0.100	-0.049	0.089	0.024	-0.020	0.007
Social category diversification	0.014	-0.053	0.050	0.067	0.152	-0.076
R^2	0.011	0.007	0.013	0.006	0.022	0.005
Adj-R^2	0.000	0.000	0.000	0.000	0.000	0.000
F	0.515	0.314	0.622	0.285	1.015	0.254
D-W	2.044	1.826	1.514	1.548	1.514	1.935

CONCLUSION AND SUGGESTION

The major objective of this study is to identify the interrelationships among social capital, leadership style, modularity, and team member diversification on NPD performance. Based on the results of this study several conclusions and implications based on these conclusions are drawn.

The first conclusion is that higher level participating style of leadership and higher level of social capital will bring better NPD performance. That means NPD leaders who adopt participative leadership style will result better performance in product prototype development and launch proficiency, technological core competency, market forecast accuracy, cycle time, and innovation if the NPD members are willing to interact with other members. Participating style has no effect on reducing product design change from product prototype to volume production. It's possible that participating leadership style let members to heavily participate project goals, it inevitable will face divergence in opinions. When members have divergence in opinions, it could result product design continuously change to fit different opinions of the team members. It is suggested that NPD leaders should try to enhance member interactions and share multiple sources of information in NPD project. These results are consistent with Nieto, Shim and Lee (2001) who conclude that project leaders differ not only in the general level of influence but also in how to mix various influence tactics, in the R&D project, leader adopts relational behaviors will get higher output.
The second conclusion is that higher level selling style of leadership and higher level of social capital will lead to better NPD performance. But, selling leadership style seems do not influence significantly the design change frequency and product development cycle time. It is suggested that when followers have no ability and willingness, the leader should adopt selling leadership. At that same time, leader should increase followers formally or informally to interact and share multiple source of information in NPD project to get higher NPD performance. These results are consistent with Sashittal (1998) and Olson et al. (2001).

The third conclusion is that higher level of telling leadership style and higher level of social capital will bring better performance in design change frequency and innovation. But it seems that more telling style will lead to bad performance in product prototype development and launch proficiency, technological core competency. Hersey, Blanchard, and Johnson (1996) suggest that, when the followers are unwilling and not capable to work, the project leader should use telling leadership style to lead project members to get better performance. Base on these results, project leaders adopting higher telling leadership style in NPD project may cause staff's bad feeling, and result in bad performance in product prototype development and proficiency and technological core competency. In the process of innovation, telling leadership style has significant effect on NPD performance, but the explain variance is small. It's possible that there are other factors that have been neglected from the model. In fact, there are many factors that will effect innovation. In the process from prototype design to volume production, the multiple source of information can make employees to make fewer mistakes and decrease the frequency of design change. These results are consistent with Howell and Higgins (1990) who state that leader adopts older of leadership to more closed-end project will lead more performance of new product development.

The fourth conclusion is that higher level delegating leadership style with higher level of social capital will bring better performance in product prototype development and launch proficiency, technological core competency, and innovation. Hersey, Blanchard, and Johnson (1996) suggest that when followers have ability and willingness to work, leaders should adopt delegating leadership style to followers. Leaders should increase social capital when they face the project members who are in the highest level of readiness. In the early stage of new product development, leader delegates authority to followers who have ability and willingness that will satisfy their achievement-oriented performance. These results are consistent with Sydow et al. (1998) who conclude that social capital on network processes and effectiveness will speed up NPD performance from structurationist perspective.

The fifth conclusion is that NPD adopting modular design will lead to higher performance on prototype product development and launch proficiency, technological core competency, market forecast accuracy, and product development cycle time. That means that NPD project leader could try to use modular design to development new product. If project team has some previous successful experience, project team may just change some modular to create really new product. Because of the past experience, project team will have better understanding of market to assure the forecast market and to reduce product cycle time. At the same time, the key to successful product modularization is product architecture, a scheme by which functional elements of a product are allocated to structurally independent physical components (Ulrich, 1995; Sanchez, 2000). In the process of designing product architecture, project team members must know the core function of product that could acquire competency to reach diversity functional modules.

The last conclusion is that modular level of new product will lead to better NPD performance except for technological core competency. Potential benefits of modularity include: economies of scale, increased feasibility of product/component change, increase product variety, reduce order lead-time, decoupling tasks, and the ease of product upgrade, maintenance, repair, and disposal (Nevins and Whitney, 1989; Pahl and Beitz, 1988; Corbett *et al*., 1991). These results are consistent with Nieto and Phal and Beitz (1988), Chen and Liu (2004), Huang (2000) and et al. who conclude that modular architectural approach has been an important perspective in product innovation research. The manufacturing industry is

undergoing a major paradigm shift that is taking it from traditional manufacturing into a world of agile manufacturing. An agile corporation should be able to rationalize its manufacturing facilities and produce a large variety of products at lower cost in time. Designs of modular products and reconfigurable processes are crucial to agile manufacturing. Modular product design is becoming a focus and is frequently stated as a goal of good design practice in current engineering areas.

The study results can not confirm that team member diversification has significant effect on NPD performance. This study divides team diversification to two aspects: knowledge diversification and social category diversification. There are different results if we adopt different aspect. Team member characteristics, team cohesion, and environment will affect performance by member interaction (McGrath, 1964). In the process of team member interaction, characteristics of person and task interacts job and team characteristics, just consider personal characteristics is not enough (Salas, 1992). It should combine with task characteristics and personal characteristic. Team member diversification comes from different background, which generates different faith in team and may result many conflicts which reduce team performance (Wiersema and Bantel, 1992). Good and Nelson (1971) suggest that the same years of service have more chance to produce social interaction and team cohesion than diversiform seniority. In the diversification of background function, industry diversification and expertise diversification will have negative effect in communication of information (Smith, 1994).

Although the results of this study are fruitful and the results may contribute to the existing literature for further validation, several suggestions could be made for academicians and business practitioners.

First the model test is conducted in the manufacturing industry in Taiwan. Although this approach enables us to conduct an in-depth study and controls for a considerable amount of environmental ‘noise’ in an important industry, it might limit our ability to generalize our findings. Although this should be subject to further empirical verification, we do not see any a-priori reasons why the effects observed would be different in other industries.

Second, research may use experimental research to confirm the results of this study. For example, business simulations could be adopted to reflect a real environment, and to manipulate different situations of team members. Third, the response rate of this study is very low. This study collects sample data through mail survey. It takes time and efforts to get the answers from the respondents. However, for the respondents, they don’t have pressure to answer the questionnaires. For the future research, the reasonable response rate should be maintained to support the quality of the data.
Even though most of the framework and the relationships between variables have been proved to be significant, the comprehensive model using LISREL test seems to indicate that there are still plenty of rooms to revise and modify results of this analysis and further validation may be required.

Hersey, Blanchard, and Johnson (1996) brought up situational leadership model that a successful leadership style should consider the ability and willingness of followers. In this study, it suggests that further studies can measure the maturity of follower to fit leadership. Further studies should try to find the best leadership model amount leadership style, social capital, and follower’s maturity or characteristic on NPD performance.

Finally, in this study, team member diversification has no effect on NPD performance. This study sums up diversity value to represent diversification. It uses arithmetic average which assumes that different category has the same weight. Further study may find fair weight to show reasonable formula on behalf of team member diversification.

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FOREIGN INVESTMENTS AND DEVELOPMENT OF LIFE INSURANCE COMPANIES. CASE OF POLAND.

Adam Sliwinski, Warsaw School of Economics, Poland
adamy@poczta.onet.pl

ABSTRACT

The main aim of this paper is to demonstrate the relationship between changes in the ownership structure and the development of life insurance companies in Poland. The simple regression model is used to reveal the relation. The findings of this study, that the solvency ratio, overall indebtedness ratio, premiums retention ratio and profitability ratio on technical activity and sales are positively related with the changes in the share of foreign capital and especially that the claims ratio is negatively related, suggest that foreign investments have greatly influenced the development of the life insurance industry in Poland during the transition period.

Key words: ownership structure, insurance, performance

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BUSINESS PERFORMANCE IMPROVEMENT THROUGH MANAGING INTANGIBLE ASSETS

Chaichan Chareonsuk, Shinawatra University, Thailand and
Chuvej Chansa-ngavej*, Shinawatra University, Thailand
chuvej@shinawatra.ac.th

ABSTRACT

This paper aims to establish empirically the interrelationship of three elements of intangible assets: learning and growth, internal business process and external structure and the business performance. The cause-effect relationships between intangible assets and business performance were investigated in companies of various business sizes, business sectors and age of business establishment. A total of 3,084 questionnaires were distributed to the top management of member companies of the Thai Chamber of Commerce. Responded questionnaires were screened for completeness and reliability. The number of qualified responses were 304 and the data were analyzed using the Structural Equation Modeling technique.

The three elements of intangible assets were found to be independent. The type of business, i.e. non-service and service sectors, has not been found to yield significantly different result. However, the cause-effect relationship results of the business size and the age of business establishment are significantly different. Moreover, the commonly assumed cause-effect relationships were confirmed, i.e. the element of learning and growth has influence on internal business process, the element of internal process has effect on external structure and the element of external structure, in turn, has effect on business performance. It was also found that the element of internal process has direct effect on business performance as well.

These findings will enable top management in each size of business, business sector and age of its company to understand the cause-effect relationships and importance of elements of intangible assets (learning and growth, internal business process and external structure) and business performance. Now that the cause-effect relationships are positively identified, long-term strategies for intangible asset management may be formulated and recommended to management. Budget allocation and management can now be more properly focused and controlled to increase sustainable competitive advantage.

Keywords: Intangible assets, Balanced Scorecard, Business Performance, Structural Equation Modeling, business strategy

INTRODUCTION

The current economic crisis has spread over all business sectors. Some businesses have had to close down and gone bankrupt. Profit and loss are normally used as the main financial performance indicators in the balance sheet and annual financial reports. However, annual financial reports might not reflect and influence the crafting of long-term strategies. Financial profit alone could not guarantee the long term survival of companies under economic crisis and a drastically dynamic business environment.

The investment of tangible assets such as equipment, machineries, building, etc, is also recorded in the balance sheet. Whereas the cost of expenses in brand building, customer database, training, product development, information technology, etc, are usually treated as part of the operation cost and marketing expenses. This simple accounting record mechanism has no linkage with long-term strategies and budget allocation. Intangible assets have been widely studied during the last decade.

Intangible assets are defined as non-financial assets without physical substance that are held for use in the production or supply of goods or services or for rental to others, or for administrative purpose (Epstein and Mirza, 2005). Intangible asset is an accounting term, while intellectual capital is a term used in the management field. They both refer to the same thing. Since an increasing share of market value in this era is not represented by inventory or physical assets.

Investments in intangible assets are usually not documented in a proper and systematic manner because of data non-availability. Consequently, reasonable estimates of the future performance potential of an organization could not be provided to the management. It is intriguing to note that the cause-effect relationships between marketing, production and human resource and financial performance have not so far been made operational. Prior to the knowledge era, business lived in the world of tangibles, which worked well with the traditional accounting practices. However, things are different in today's world of intangibles. Modern management style and strategic crafting have adapted in response to global competition and volatile economic environment. The industrial age management has been replaced by the knowledge age leadership, with corresponding transformational effects on the economy and workplace. The focus on tangible assets in industrial age has made a paradigm shift to intangible assets in the knowledge age. As a consequence, issues concerning intangible assets are now more widely researched and practiced. Intangible assets are of increasing importance for the corporate value creation processes of all kinds of organization.

To be sustainable, companies need to understand and be able to manage intangible factors, including organizational learning and growth, internal process and external structure. The intangible assets are the competitive edge over competitors. Ittner (2008) suggested several previous studies provide at least some evidence that intangible asset measurement is associated with higher performance, however, many are limited by over-reliance on perceptual satisfaction or outcome variables, inadequate controls for contingency factors, simple variables for capturing complex measurement practices, and the lack of data implementation practice. In this paper, the balanced scorecard strategy map (Kaplan and Norton, 2004) is used to provide a framework to illustrate how strategy links intangible assets to value creating processes. The measures in the four perspectives are linked together by cause-effect relationships. The company builds the core competence and training to support the internal process. The internal process creates and delivers the customer value proposition. When the customers are satisfied, the sales and profit are delivered in terms of financial performance.

This paper explores the cause-effect relationship of intangible assets, learning and growth, internal process and external structure to business performance. The model is an attempt to refine and extend the balance scorecard strategy map. A total of 3,084 questionnaires have been distributed to the top management of the Thai Chamber of Commerce. The subjects are in various business size, business sector and age of business establishment. The questionnaire

responses were screened for completeness and reliability. The number of qualified responses was 304, which was the total number of responses used in the analysis. The Structural Equation Modeling technique was the analytical tool applied in this empirical investigation. The model fit testing process is illustrated in Figure 1. The initial step in the analysis of the data focuses on examining the frequency distribution and the meaning and standard deviation for each item or variable considered in this research. The next step in data analysis is to assess the validity of measures. Here the study uses item-total correlation, confirmatory factor analysis and the Cronbach alpha coefficient. The initial data analysis and reliability and correlation analyses are performed using the SPSS statistical package. Furthermore, the structural equation modeling EQS program (Bentler, 1995) is used to perform the confirmatory factor analysis, discriminant validity tests and testing of the structural model.

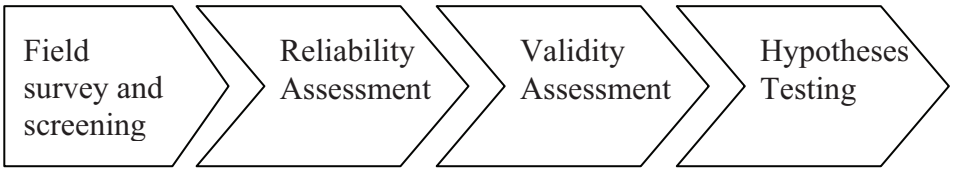

Figure 1. Model fit testing process

LITERATURE REVIEW

During the last two decade years, several studies, Kaplan and Norton (1992), Sveiby (1997), Edvinsson and Malone (1997) and Bontis (2000), have variously attempted to categorized intangible assets. There are common categories of intangible assets as follows:

- Customer/ External structure/Relation capital
- Internal process/ Structural capital
- Learning and growth/human capital/Competence structure

There are several intangible assets indicator in each intangible assets element. By using the categories developed by Hall (1993), Sveiby (1997), Roos et al. (1997) and Shaikh (2004) reviewed and classified the intangible assets into a framework of internal structure, external structure, and employee competence as shown in Table 1.

Table 1. Framework of Intellectual Capital/Intangible assets Indicators

External structure	Brands Customer loyalty Customer satisfaction
Internal structure **or** **Internal Process**	Process Improvement Innovation Information technology
Employee competence **or** **Learning and Growth**	Know-how knowledge Competencies Engagement

The balance scorecard is the most well-known approach that can be used for converting intangible assets into tangible outcomes although its original intent was not meant to be the measure for intangible assets, as discussed by Marr and Adams (2004) and Mouristen et al. (2005). Seggie et al. (2007) made an argument for the balanced scorecard to be the measurement tool in marketing to measure non-financial assets and provide the organization with a long-term perspective. The balance scorecard is at least partially forward-looking and partially geared toward the long-term performance of the firm. The balance scorecard concept has been examined the performance measurement of bonus plan in major financial services firm. Ittner et al. (2003) recommended that the future research on balance scorecard adoption and performance consequences must move to encompass the entire implementation process.

Kaplan and Norton (2004) developed the balance scorecard strategy map to explain the relation of learning and growth, internal process and customer perspective. The concept of cause-effect relationships separates the balanced scorecard from other performance management systems. The measures appearing on the scorecard should be linked together in a series of cause-effect relationships to tell the organization's strategic story. Increasing promotional expenses will lead to the increase in brand value. Increased brand value will lead to higher sales revenue. The investment of human capital will create the continuous learning and growth in the organization. When the employees have more experience and knowledge, they can create the internal process which serves and fulfills customer satisfaction. The profit and revenue are the final outcomes of this causal chain.

Heskett et al. (1994) explained the linkage of the above model that investment in employee training leads to improvement in service quality. Better service quality leads to higher customer satisfaction. Higher customer satisfaction leads to increased customer loyalty. Increased customer loyalty generates increased revenues and margins. There are linkages among learning and growth, internal process, customer, and financial performance. Olve et al. (1999) reported that Halifax applied the balance scorecard in business and found the relation that if we have the right staff, we will get "doing the right thing" and customers will be delighted. When the customers are delighted, we will get more business.

There are many functions involved in aligning the intangible assets with strategies. Each function has to build its own intangible assets in order to deliver and convert them to financial performance. Chareonsuk and Chansa-ngavej (2006) found that most of companies in the Stock-Exchange of Thailand have functional organization structure.

The intangible assets are linked to performance. The balanced scorecard has been widely used in formulating business strategy. Green and Ryan (2005) proposed the framework of intangible valuation areas for facilitating the systematic and repeatable identification of intangible assets balanced scorecard. It is designed to align the value drivers of intangible assets with its business strategy. Understanding the value of its intangible assets helps a business to develop, sustain and enhance its mission effectiveness and competitive advantage. Chareonsuk and Chansa-ngavej (2008) proposed the framework for intangible assets management in business and industrial organization. The framework refines the strategy map concept in the balanced scorecard approach for use in intangible assets management. Intangible assets belong to different functional departments. They must be carefully monitored and properly nurtured by the organization. Intangible assets depend not only on the type of functional departments but also the type of industries.

The data that could be gathered on the issues of intangible assets could be divided into two types as shown in Table 2.

Table 2. Intangible assets relationship analysis methods

Methods	Advantage	Disadvantage
Direct way : Financial quantitative data	Direct analysis from reliable financial data	Difficulty to obtain the financial data in some countries.
Indirect way : Questionnaire	Widely distribute to all industries in any conditions.	The results are highly susceptible to the questions' design and the respondent's attitude. (Chen et al. 2005)

There is some difficulty in obtaining data of intangible assets in financial reports for direct testing of the relationship. Thus, there are several empirical studies using the questionnaires as shown in Table 3.

Table 3. Previous Empirical studies

Studies	Methodology	Empirical Finding/ Result
Bontis et al., 2000	Questionnaire 107 respondents both service and non-service industries. Analyzed by structural equation modeling and Partial Least Squares	Intellectual capital has a significant and substantive relationship with business performance regardless of industry sector.
Carmeli and Tishler, 2005	Questionnaire 99 respondents of general management of local authority in Israel. Use multivariate analysis approach, robust canonical analysis (RCA)	Intangible organization elements (managerial capabilities, human capital, perceived organizational reputation, internal auditing, labor relations and organizational culture) have a significant positive effect on the performance of the organization.
Nagar and Rajan, 2005	Marketing and customer satisfaction survey 87 retail banks. Analyzed by linear regression.	Customer relationship activities link to business performance.
Chin et al., 2005	Gather financial data of 1,386 samples companies listed. Trademark value estimation by Seethamraju (2003).	Trademark/Brand is positively associated with firm's performance.
Wang and Chang, 2005	Gather data from 131 IT firm in Taiwan and analyzed the model by partial least square (PLS) method	Human capital has no direct effect on performance. Innovation, process and customer capital have direct effect on performance. Human capital directly affects innovation and process capital. Innovation and process capital further influence performance.
Chen et al., 2005	Gather data from 4,254 registered companies and analyzed the hypotheses by statistic testing.	Intellectual capital has a positive impact on financial performance.
Cabrita and Vaz, 2006	53 banks (253 samples) in Portuguese banking were tested using PLC testing model	Intellectual capital is significantly related to the organizational performance.
Moon and Kym, 2006	200 questionnaire analyzed and using SEM (AMOS) for model testing	Human capital has a positive effect on relational capital and that both human and relational capital affect structural capital
McKeen et al., 2006	90 respondents in US, and analyzed the hypotheses by PLS method	Knowledge management has direct relation to organizational performance. Organizational performance has direct relation to financial performance. No direct relation between knowledge management and financial performance.
Liu and Tsai, 2007	Questionnaire 560 manager from Hi-Tech companies in Taiwan. Statistic *t*-test and ANOVA are used.	Knowledge management has a positive effect on business performance.
Cheng et al., 2008	Directly obtain financial data of 56 companies and analyzed 23 indicators by Tobit's model	Innovation, customer, human and contract capital have some impact on intangible assets.

RESEARCH DESIGN AND METHODOLOGY

The cause-effect relationship is urged in strategic mapping (Kaplan and Norton, 2004). There are also several researchers, i.e. Huselid and Becker (1997), Hitt et al. (2001), Liu and Tsai (2007), studies the relationship between learning and growth and business performance The hypotheses model is constructed in Figure 2.

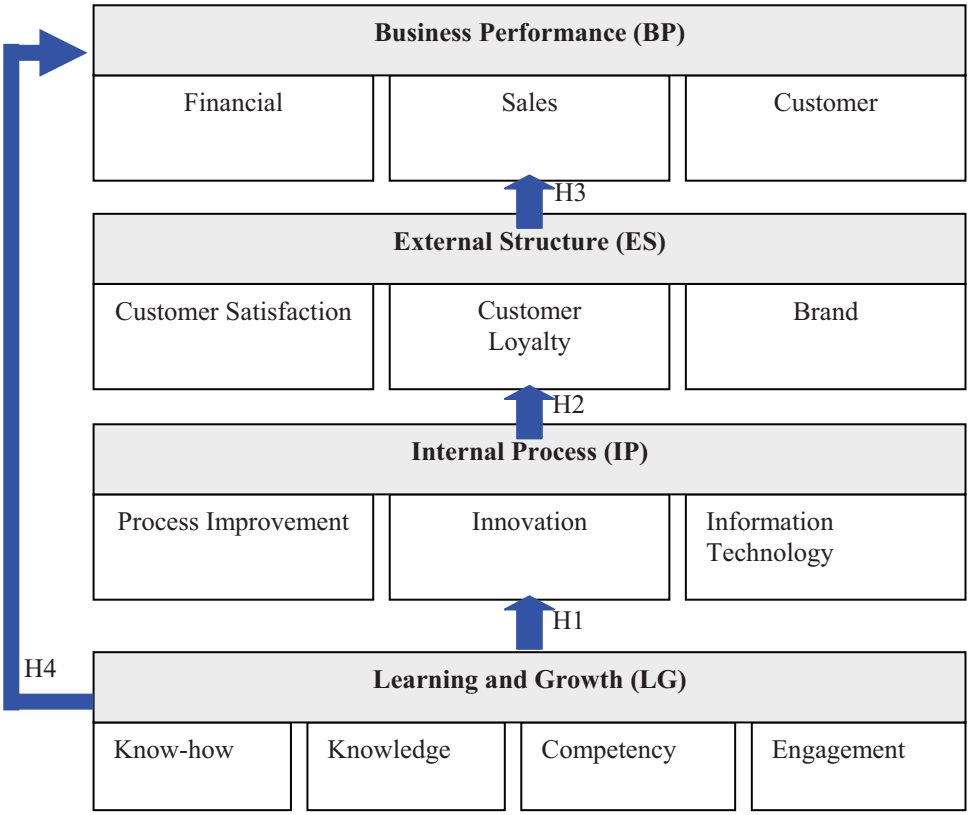

Figure 2 Research Hypotheses Testing Model

H1 : Learning and Growth is positively related to Internal process

H2 : Internal process is positively related to external structure

H3 : External structure is positively related to business performance

H4 : Learning and growth is positively related to business performance

There were several studies on the testing and accepted criteria. Accepted criteria in each statistical testing of previous studies, Steenkamp and Trijp (1991), Nunnally and Bernstein (1994), Ferguson et al. (2005), Hair et al. (2006) and Byrne (2006) shown in Table 4.

Table 4. Accepted criteria in each statistical testing

Testing	Purpose	Accepted criteria
Reliability assessment	Questionnaire consistency	Cronbach's alpha exceed 0.7 Item-total exceed 0.4
Convergent validity	Scale correlation with other measures of the same construct	CFI (Comparative Fit Index) exceed 0.9 NNFI (Non-Normed Fit Index) exceed 0.9 RMSEA (Root Mean Square Error of Approximation) lower than 0.05-0.08 AOSR (Average off-diagonal absolute standardize residual) lower value to zero, better fit *t*-value exceed 2.0 at $p<0.05$ Standard loading exceed 0.6
Discriminant validity	Construct different from the other construct	$\chi 2_{\text{constrained}} - \chi 2_{\text{unconstrained}} > 3.84$, $p<0.05$ correlation+2 (std. error) < 1
Hypotheses	Model fit	$\chi 2/_{df}$ Ratio between 1-3 CFI exceed 0.9 NNFI exceed 0.9 RMSEA lower than 0.05-0.08 AOSR lower value to zero, better fit *t*-value > ± 2.58, $p<0.01$ *t*-value >± 1.96, $p<0.05$ *t*-value > ± 1.65, $p<0.1$

Prior to doing the hypotheses testing, there are several testing steps as described in Figure 1. The detail of empirical result in each step is explained as follows:

Step 1: Field survey and Screening

Questionnaire was the primary source of data of this paper. An appropriate design of the questionnaire is crucial to ensure the success of the study and the achievement of the research objectives. The questionnaire in this paper is constructed by using the step-by-step procedure as illustrated by Churchill (1995). The questionnaires in each intangible assets indicator are adopted from the literature on the measures of intangible assets to business performance and constructed into a total of 68 questions. The questionnaire has to be clear and has simple wording before being dispatched and distributed to top managements of registered member companies in the Thai Chamber of Commerce. The members of the Thai Chamber of Commerce are in various types of industries and size of companies. They have reliable financial and general information. The questionnaires have been distributed to 3,084 members. There were 361 respondents. Some of them have incomplete information. The qualify respondents are only 304 which are used in further analysis. The next step of model testing procedure which is shown in Figure 1 is reliability assessment.

Step 2. Reliability Assessment

Cronbach's coefficient alpha provides an overall indicator of the correlations among a set of items used to measure a construct. It ranges from 0 to 1 (Hair et al., 2006). In general marketing and management fields, the Cronbach's coefficient alpha are accepted at minimum of 0.70 (Nunnally and Bernstein, 1994). However, before evaluating the reliability of scales, item-total correlations were initially calculated to purify the measures. The principle of this procedure is to indicate which items that do not belong to the content domain of the constructs. The items which exhibited item-total correlations below 0.40 were then eliminated from further analysis (Nunnally and Bernstein, 1994). There is only one question removed because it has lowest item-total correlations, 0.3. The Cronbach's alpha in this paper is shown in Table 5.

Table 5. Overall reliable assessment result

Intangible assets element	Intangible assets indicator	Cronbach's Alpha
Learning and Growth	Know-how	0.80
	Knowledge	0.72
	Competency	0.83
	Engagement	0.79
Internal Process	Process Improvement	0.79
	Innovation	0.85
	Information	0.81
External Structure	Customer Satisfaction	0.88
	Customer Loyalty	0.73
	Brand	0.88
Business Performance	Financial Performance	0.92
	Sales performance	0.93
	Customer fulfillment	0.87

All Cronbach's alpha are higher than 0.7. Therefore, on the basis of these preliminary analyses, each items seems to make a good contribution and sufficiently reliable. All questionnaires in each intangible assets element are consistent and reliable.

Step 3: Validity assessment

There are two types of validity assessment, convergent and discriminant validity. The convergent validity is to analyze the scale correlate positive with other measures of the same construct. Two models are tested in convergent validity analysis. The first model comprises 10 intangible assets indicators measuring 3 first order constructs/intangible assets those being learning and growth, internal process and external structure. Using the structural equation modeling, EQS program, all diagnostic indicators for the measurement model were satisfactory and suggested a goodness fit, (CFI 0.99, NNFI 0.98, RMSEA 0.08, AOSR 0.03, the lowest t-value 17.03 and lowest standard loading 0.82). The second model assesses the existence of a multi-dimensional business performance which is conceptualized and operationalized as a higher order construct composed of three first order dimensions those are financial performance, sales performance and customer fulfilling performance. Also, all diagnostic indicators for the measurement model were satisfactory and suggested a goodness fit, (CFI 0.96, NNFI 0.95, RMSEA 0.09, AOSR 0.05, the lowest t-value 8.3 and lowest

standing loading 0.63. Thus, the intangible assets indicator in each constructs/intangible assets is positive correlate with other indicators in the same construct. The knowledge, know-how, competence and engagement are positive correlate in learning and growth. Process improvement, innovation and IT are positive correlate in internal process. Customer satisfaction, customer loyalty and brand are positive correlate in external structure. Lastly, financial, sales and customer fulfillment performance are positive correlate in business performance.

The discriminant validity analysis is to analyze the degree of each construct variable different from other construct variable. In this study, there are 4 construct variables which are learning and growth, internal process, external structure and business performance. Structural equation modeling was utilized in the present study to assess the presence of discriminant validity among the study measures. The result of discriminant validity analysis is shown in Table 6.

Table 6 Discriminant Validity Analysis

Intangible assets elements	Learning & Growth	Internal Process	External Structure	Business Performance
Learning & Growth				
Internal Process	0.88 (0.02)[a] 141.51[b] 63.21[c]			
External Structure	0.79 (0.03) 105.71 54.72	0.88 (0.02) 85.12 30.23		
Business Performance	0.55 (0.06) 198.99 71.90	0.55 (0.05) 139.26 37.43	0.67 (0.05) 158.86 44.64	

Note: Entries below the diagonal show (a) ø coefficients, reflecting correlations among constructs and standard error in the parentheses (b) difference in chi-square from fixed (ø =1.00) model and free (ø estimated) model (c) chi-square for free model

The results in the above table indicate that, in all cases the pairs of construct variables were not collinear, which provide the evidence of discriminant validity. The each pair of difference constrained and unconstrained chi-square models is greater than 3.841 at p <0.05. In addition, each pair of constructs a confidence interval was calculated around the estimated correlation by using twice the standard error. Thus, both chi-square difference tests and confidence intervals assessment provide evidence of discriminant validity among the study constructs. Each construct variable is difference from other constructs. In this study, the intangible assets indicators in each construct variables (learning and growth, internal growth, external structure and business performance) do not correlate with each others.

Step 4. Hypothesis testing result

The result of 304 respondents in various business sectors, ago of business and size of business. The testing results in Figure 3 are simulated by EQS program.

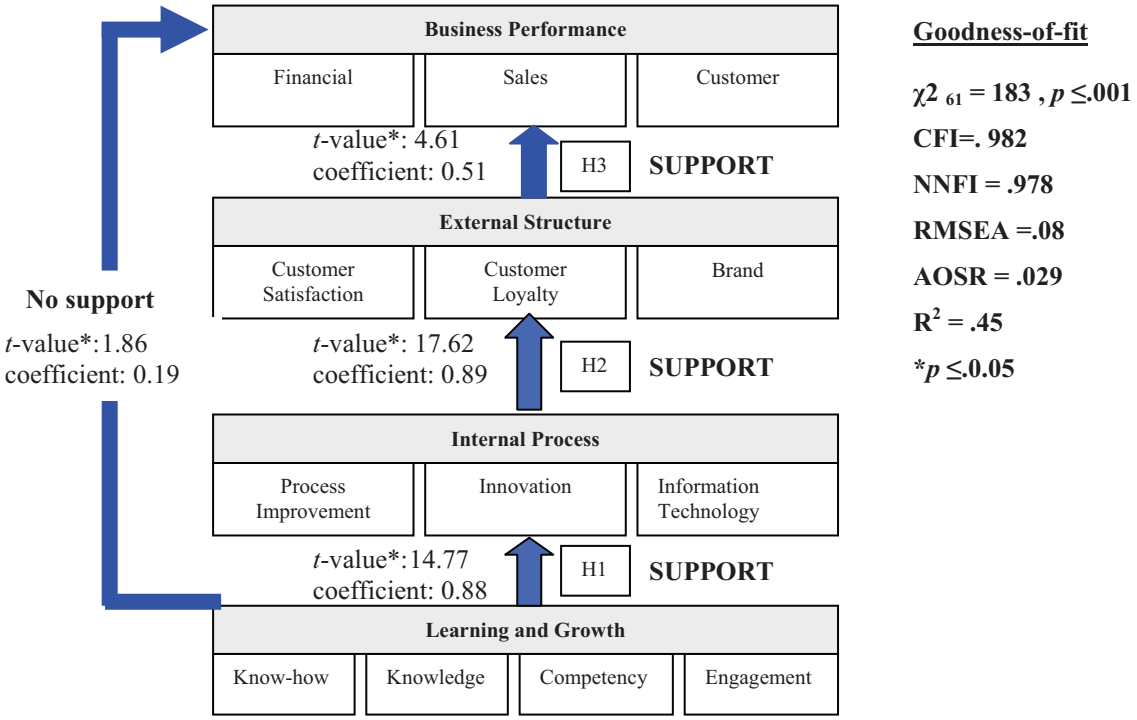

Figure 3. Structure model result

All diagnostic indicators show significant evident goodness-of-fit statistic, CFI=0.982, NNFI=0.978, exceeding 0.9. The RMSEA is equal to 0.08 and a small AOSR. With the large sample size, 304 respondents, the significant chi-square and degree of freedom ratio is acceptable. The model fits relative to the goodness-of-fit statistic result. All hypotheses are supported except the relationship between learning and growth and business performance at $p \leq .0.05$. This structural model solution produces an R^2 value of 0.45 which suggests that the structural model explains 45 percent of the variance in business performance. It has very strong explanatory power for this model compared with the previous studies in Carbrita and Vaz (2006) 0.44, Wang and Chang (2005) 0.43 and Bontis et al. (2000) 0.37.

CONCLUSION

Intangible assets are involved in all levels of value chain in business. The foundation of intangible assets in business is learning and growth. The knowledge, know-how, employee competence and engagement are the intangible assets in learning growth which are positive effect to internal process (process improvement, innovation and information technology) which is the same result as Wang and Chang (2005). The internal process is expended positive effect to external structure. Finally, external structure affects business performance. The learning and growth is the primary foundation factor to lead the business performance. The three elements of intangible assets are independent as illustrated in the validity testing. The linkage of three elements is confirmed the strategic mapping of the balance scorecard. The hypotheses testing does not support the cause-effect relationship between learning and growth to business performance. The learning and growth element has indirect effect to business through the value chain in balance scorecard, internal process and customer proposition.

MANAGERIAL IMPLICATIONS FOR INDUSTRIAL MANAGEMENT

No strategic recommendations were noted from past researches. Management practitioners need not only cause-effect relationship of the model testing results but also long term strategies in their business. When the top management or strategist realizes the cause-effect relationship of those three intangible assets, the recommendation strategies are discussed in the Figure 4. The recommended long-term strategies are retrieved from the high score question in each intangible assets indicators. Understanding the value of intangible assets help a business to develop sustainable and enhance its mission effectiveness and competitive advantage.

Intangible assets are the strategic key for long term profit prospect and sustainable competitive advantage. The setting of key performance index and investment has been allocated and monitored by the above guideline strategies. When the top management has crystallized strategies, they have good management and monitoring. Creating a culture of measurement-driven intangible assets and business performance helps top management understand how to drive the greater return from intangible assets investment.

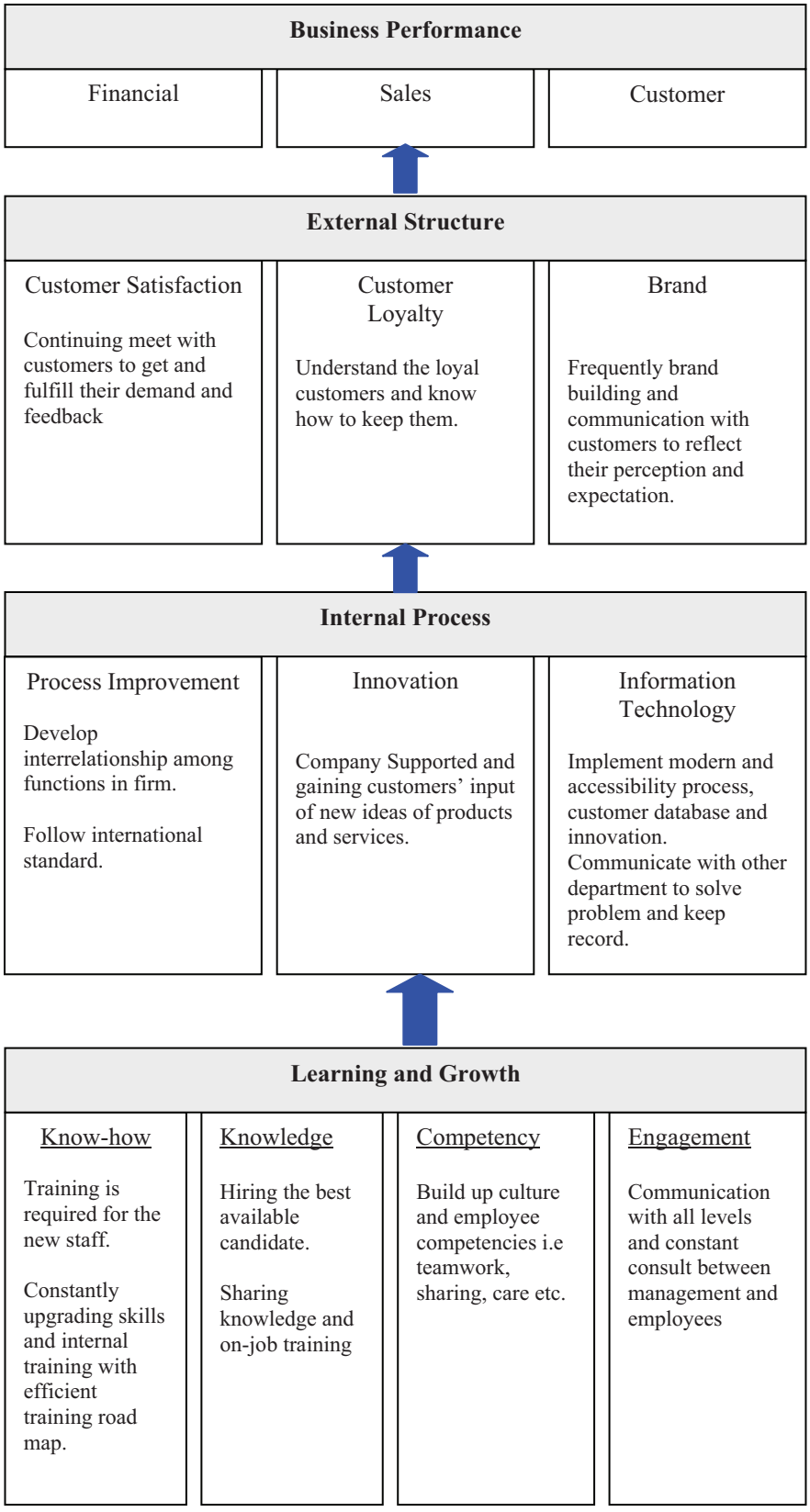

Figure 4. Intangible assets strategies to improve business performance

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HRIS EFFECTIVENESS USING DATA MINING TECHNIQUES.

Jayanthi Ranjan, Institute of Management Technology, Ghaziabad (U.P)-India
jranjan@imt.edu
Vishal Bhatnagar, Ambedkar Institute of Technology, Shakarpur, Delhi-India
vishalbhatnagar@yahoo.com

ABSTRACT

Organizations that are enlightened enough to recognize the importance and value of their data often have difficulty in actually realizing that value. Their data is often disconnected, inconsistent, and inaccessible. They have valuable, untapped raw data that is hidden in the reams of transactional data they collect daily. Information sharing among departments and functions is difficult. Unlocking the intelligence trapped in mountains of data has been, until recently, a relatively difficult task to accomplish effectively. HR data primarily concerns transactional processing-getting data into the system recording it for reporting purpose. Understanding the Human Resource (HR) data is vital to any firm's effective HRIS.

This paper studies the adoption of Data Mining techniques on HRIS (Human Resources Information System) in any organization and presents Data Mining with respect to HRIS effectiveness.

Keywords: Data Mining; human resource information systems; HRIS; human resource data; HR data; employees.

INTRODUCTION

Rapid technological advancements, globalization, move towards knowledge-based economy and a host of other trends are changing the face of any organization. This yields to have a major impact on the role of the human resources (HR) department [40]. An important innovation within the human resources management (HRM) function is the use of Information Technology (IT), which has led to the development of computer-based Human Resources Information Systems (HRIS). In fact, HRIS as described by [27] is the backbone of contemporary HRM function.

Studies have also reported that for organizations which have adopted HRIS, the investments are small and usually address tactics and administration rather than strategy. Tactical HR applications typically refer to transaction processing for payroll and benefits administration while strategic applications make organizations more effective and competitive, especially in knowledge management and workforce planning. In many organizations, the focus of the HRIS is on administrative efficiency. However, as organizations seek to grow and compete in the rapidly evolving knowledge-based economy, the pressure continues to grow for HR to play a strategic role in the organization [46]. The growing link between HR and business strategy has organizations looking to their HR professionals for innovative programs and practices to build a more competitive workforce.

The core and major challenges the corporate face in today's competitive environment is management of large volume of data filter the useful data and transform the filtered data into

useful knowledge. For this purpose, many firms have heavily invested in IT to help them to manage their business decisions more effectively and gain a competitive advantage. By implementing from Enterprise Resource Planning (ERP) to Customer Relationship Management (CRM), Supply Chain Management (SCM), and E-Commerce applications, the firms have taken a big step in automating their business processes [31]. Today all firms immediately respond replying as 'My People' when asked to specify the most important resources in their organizations. While lip service is given to the key human resource asset, surprisingly in reality, little time or effort is given into directing, conserving and leveraging that human resource asset. Data Mining, also called as knowledge discovery in large data, enables firms to make calculated decisions by assembling, accumulating, analyzing and accessing corporate data. Tools like query and reporting tools, On-Line Analytical Processing tools (OLAP), and Decision Support System (DSS) are used in Data Mining applications.

These organizations have been constructing their IT systems with nonintegrated single-point solutions. (For example, they have different departmental data warehouses built on different platforms using combinations of tools, some nonstandard, some with expired maintenance support, and some prebuilt in a tool purchased from a vendor no longer in business.) Implementing quick-fix solutions can become a software maintenance quagmire. With hindsight, even presumably researched software system purchases can still result in redundant tools, data inconsistencies, duplication of effort, and ultimately high IT operating expenses, with unintended barriers blocking systems from cleanly communicating among themselves. All organizations are reaching a point where it is important for computers to talk to other computers.

The concept and role of HRIS have increased parallel to business related technological advancements. All firms have realized and recognized that in a knowledge-intensive, innovative-or-die world; Human Resource Information System's role can not be limited to just administrative work of hiring and firing but has lot to do more. The HRIS also called as Human Resource Management Systems (HRMS) have become full fledged business advisors, beyond employee advocates. But while HRIS have appeared in increasing numbers as the cost of computing power has declined, many systems seem to have been acquired simply because they were affordable and not because organizations sought to use the computer as a means to more effective human resource management.

[25] described an understanding of how the Human Resource (HR) and the Information Technology (IT) management should complement each other for improved communication and competitiveness. [39] Emphasized on importance of organizational theory that makes difference while implementing Data Mining in an organization.

In a global competitive world, top management requires more and more information from their Human Resource (HR) departments. The management wants hard data on turnover, hiring, comparisons of compensation and benefits, ethnic, gender and cultural distributions to evaluate trends, anticipate possible changes in the workforce or the environment. It is necessary for HRIS to become more strategic, and more concerned with the quantifiable data. The objective of the paper is to highlight the role of Data Mining for effective HRIS.

The rest of the paper is organized as follows: In section II, related research is presented. I broadly describe the concepts of Data Mining in section III. Section IV discusses HRIS. Section V explains the techniques of Data Mining. Section VI describes effective HRIS using Data Mining. Section VII concludes the paper.

RELATED WORK

The concept of Data Mining is not explored more in context of HRIS. The work by [34] described the three major techniques of Data Mining namely Association, Clustering and Prediction on Human Resource (HR) data. [37] Presented the importance of Data Mining in Human Resource Information Systems and described thoughtful issues of HRIS with respect to Data Mining.

[43] Showed HRIS implementations lead to cultural considerations in any organization. [51] Described conflicts between information systems approaches and HRIS initiatives. [2] Mentioned that it is unfortunate that in the past many organizations have not gone beyond the automate strategy in HRIS developments.

[28] Explained the role of Data Mining applications on strategic and competitive advantage [41] points out on the patterns in human behavior to some extent for helping to predict how people will react to certain events. [36]) briefly discuss on the regression techniques, neural network applications in personnel performance and retention in Human Resource (HR) and personnel selection. [35] Stressed on the importance of information collection, transforming such information to patterns, for supporting decision making. [32] Mentioned the need for Data Mining for capturing knowledge in communities, for analyzing the co-occurrences of concepts, rules extractions, ontologies, classification grids etc. For HR effectiveness, investments in HR [30] are must for competitive advantage. [50] Presented various HR policies conceptualized by managers in an organization. [47] Suggested models for holistic knowledge framework in organizations. [23] stress on the value of performance measurements in organizations. [42] proposed the impact of training on the workforce for effectiveness in enterprise applications.

[53] described that Human Resource (HR) professionals are now able to give more time to strategic business decisions as the development of technology has allowed for the automation of many transactional HR processes. [3] Opinioned that the firm should put forward the organizational resources and capabilities that are usually rare, valuable, non-substitutable, and imperfectly imitable and these resources form the basis for a firm's sustainable competitive advantage. [8] Mentioned that HRMS create a sustained competitive advantage for decision making by hiring and developing talented staff and synergizing their contributions within the resource bundle of the firm.

[35]) suggest that some firms may use the data only for administrative purpose, some may transform this data into useful information, and some may analyze the patterns on the obtained information for support in decision making. [51] Described conflicts between information systems approaches and HRIS initiatives. It is unfortunate that as mentioned by [2] that in the past many organizations have not gone beyond the automate strategy in HRIS developments.

DATA MINING

Data Mining is the process of extracting information from large data sets through the use of algorithms and techniques drawn from the field of Statistics, Machine Learning and Data Base Management Systems [19]. Traditional data analysis methods often involve manual work and interpretation of data that is slow, expensive and highly subjective [18]. Data mining techniques track the data of the organizations that have thousands of employees a multitude of employment related information, extract the patterns contained in these HR databases by providing some insights like employee retention details, compensation planning, projecting risks and opportunity identifications and assessments.

In HR systems, for effectiveness, lots of data consolidation need to be done. Data Mining has a direct impact on the analytical results that will drive business decisions [5]. In understanding the employee, the complexity has increased dramatically because many departments, many employees, and many sophisticated tools have emerged in organizations. But with Data Mining, one can predict how likely someone will do something we are interested in, in real time [10]. It uses the extracted useful information from large data bases to make critical business decisions [10].

The applications of HRIS using Data Mining give opportunities to generate adhoc or standardized reports from specific sets of data. Researchers have established that [28] Data Mining applications when implanted effectively can result in strategic planning and competitive advantage. Data Mining as pointed out by [54] can be performed on a number of different databases and data repositories that include relational data, transactional data, data warehouse, web data, data streams, flat files, time series data etc. Data Mining includes various queries, reports and decision support tools based on historical data of the organization and can even predict for future perspective.

Organizations tend to write off Data Mining techniques since statistical analysis is routinely performed in all departments. The difference between Data Mining and Statistics is that Data Mining automates the statistical process resulting in several tools [5] Statistical inference is assumption driven in the sense that a hypothesis is formed and tested against data. Data Mining, in contrast is discovery driven. That is, the hypothesis is automatically extracted from the given data.

Some key employees unexpectedly quit in organizations, so how does a firm quickly fill the vacated positions. What do the organizations need to change and who should do it? Any firm's current workforce members are aging and set in their ways. There are patterns in why employees leave and these profiles can be applied to predict our current employees most likely to leave. The heart of the HRIS deals with retaining good employees and effective workforce planning to predict the needed number and types of skill sets of employees and expenses to meet future workload requirements. The reports received from HRIS describe various HR based reasoning like

- The groups of employees most likely to leave within the coming years.
- The reasons why employees have left in the past—measured by type of reason.
- Categories of people leaving by job type.
- Scores1 of individual employees (by name and employee ID number) in the high-risk category predicted to voluntarily leave.
- Current employees most likely to leave, broken down into categories, such as high, medium, or low risk, with the likely causes for their departure.
- Current top performers in the high-risk category and the percentages of reasons that historically caused separations of comparable positions and performers.

HUMAN RESOURCE INFORMATION SYSTEMS (HRIS).

HRIS in organizations collect basic personal and work related data in order to conduct basic HR transactions [35]. [29] give the core elements of Human Resource Information System comprising of HR application, recruitments, payroll, work flow management, reporting and analytics. HRMS can assess the best methods to meet future business objectives and learning needs of an organization with the help of DSS [17] by enabling the employees and managers to make fast, accurate, and informed personal and business decisions. [20] Provided information on reports pertaining to each HR activity like recruiting and placements, labor relations, compensation benefits that are regularly generated. [4] Founded that small firms are less likely to adopt HRM practices than medium or large firms. [33] Described the importance of Human Resources in enterprise systems. As per studies conducted [46] it is clear that for organizations which have adopted HRIS, the investments are small and usually address tactics and administration rather than strategy. However, as organizations seek to grow and compete in the rapidly evolving knowledge-based economy, the pressure continues to grow for HR to play a more strategic role in the organization [46]

[21] provide examples that include pay and benefits as a percent of operating expense, cost per hire, return on training and turnover cost. Mostly data obtained from HRIS do not provide an opportunity to seek additional relationships and patterns. For example, to assess the value of an employee who stays with the organization for an extended period of time, HR functions should provide information on the value of hiring than evaluating the cost of hiring etc.

The role of Data Mining in HRIS is to integrate various HR applications, collect data at various points in the HR databases, and use effective tools for making information available for effectiveness. Other role can be developing and improving intranet based applications for streamlining the processes, for improved predictions of employees' performance management, coordination and work flow management. Say, a separate process can be there for recruitment and selection, separate process for application tacking systems, in-house recruitments, process for training and development, performance management and also separate process for developing Employee Relationship Management. These systems help in consolidating the information across the enterprise to do everything from adhoc reporting to the analysis of complex relationships and workforce trends.

We can perform some of the interactive analytical modeling on HR data. We can detect trends and patterns in employee data which helps to further to improve the organizational culture and organizational decisions. The Decision Support Systems (DSS) can combine information from other functional areas within the firm, such as customer service and marketing, to help support HRIS decisions [9].

Generally patterns generated through Data Mining should be understood, should be valid on new or test data with some degree of certainty, potentially useful and novel. If one is searching long enough in any data set, it is possible to find patterns that appear to hold but are not necessarily statistically significant or useful [18]. A pattern will be interesting if it validates a hypothesis that the user sought to confirm. Data Mining is relevant to rank the discovered patterns according to their interestingness and filtering out the uninteresting ones ([15]. [7] Suggested that the choice of the Data Mining algorithm depends on the intended use of the extracted knowledge. Allocating man power based on demand projections requires careful task relevant data. According to the seasonal variations in demand, temporary man power can be hired to maintain service levels. The demand levels vary within one working day also, that can be used to allocate resources accordingly. Data quality may be insufficient if data is collected without any specific analysis in mind [19]. A careful process with respect to missing or noisy data is required. Whether the HRIS simply automates existing processes or supports transformational change will depend on the way it is designed and developed.

DATA MINING TECHNIQUES.

Data mining and analysis tools are designed to explore large quantities of data for comprehensive analysis to discover hidden relationships and uncover unknown patterns, trends, associations, or anomalies for the purpose of proactive or computer-automated decision making. These tools provide the ability to go beyond merely reporting *what has happened* in a business or organization to discovering *why it has happened*. They are also useful for deriving meaningful and accurate predictions. The superior data mining and analysis tools simplify and streamline both the data preparation time and the analysis process. The beauty of the data mining tools is that they enable organizations to create unique value on top of an asset they already have: their raw data. That is, the casual analyst is empowered with statistical, visualization techniques to extract the underlying business knowledge from vast deposits of data, exploit the data for predictive variables to yield validated findings, and conclusions, possibly optimize their decisions, and finally present the results in actionable forms such as customer segmentation models. Data mining provides a graphical user interface (GUI) that is designed such that analysts with only moderate statistical competencies can drive through the data mining and analysis process, while the quantitative expert can optionally go behind the scenes to fine-tune and tweak the analytical process. For example, nontechnical users can easily examine large amounts of data in multidimensional histograms to graphically compare their analyzed results derived from alternative scenarios and assumptions. The benefit is that the time delay from data access to action is dramatically shortened—and the results can be deployed across the Internet.

Associations, Mining frequent patterns.

These methods identify rules of affinities among the collections. [26] Mentioned that patterns occur frequently during Data Mining process. A frequently occurring subsequence such as staff movement and work attitude tend to have patterns in their performance. Another example in HRIS can be the claim forms submitted by the employees to the medical insurance of the organization. Every claim contains a set of medical procedures that were performed on the given employee during one visit. By defining the set of items to be 'the collection of all medical procedures that can be submitted' and the records to correspond to each claim form, the application can find, using association function, relationships among the medical procedures that are often combined together. Research shows [45] that association rules are essential beyond market basket analysis.

One can use association rules for application tracking mechanisms in recruiting, identification of patterns in employee benefits, analysis of staff movements etc.

Classification and Prediction.

The classification and prediction models are two data analysis techniques that are used to describe data classes and predict future data classes. A credit card company whose customer credit history is known can classify its customer record as Good, Medium, or Poor. To predict whether a certain employee will show a certain type of behavior implies an assumption that the employee belongs to certain type of employee group and will therefore show the certain kind of behavior. Extensive research has been done [6] on classification and decision trees.

The models of decision trees, neural networks based classifications schemes are very much useful for business decisions. Classification works on discrete and unordered data, while prediction works on continuous data. Regression is often used as it is a statistical method used for numeric prediction. While doing effective decision making for employee selection, selection of individuals to fill available jobs becomes clear and meaningful only when there are more applicants than jobs. Primary emphasis should be made on the selection measurement accuracy and predicative efficiency. Simple or multiple regressions is the basic prediction model that enables a decision maker to forecast each individual's criterion status based on predictor information.

There are procedures available to choose appropriate cutoff scores in employee selection processes. [49] Showed through case studies how neural network technology is useful from different areas of business. One can predict the likelihood of success in any HR process. Prediction and classification techniques are used in employee attrition rates(what type of employees are most likely to leave, most likely shift etc), factors to attract new customers, trends of movements of successful and unsuccessful trainings methods, predicting the percentage accuracy in employee performance etc.

Clustering.

It is a method by which similar records are grouped together. Clustering is usually used to mean segmentation. An organization can take the hierarchy of classes that group similar events. Using clustering, employees can be grouped based on income, age, occupation, housing etc. In business, clustering helps identify groups of similarities; characterize customer groups based on purchasing patterns, etc. An organization may segment the employees and discover clusters of potential employees on the basis of attributes (type of seminars, training programs attended and number of vacations availed etc). In HRIS, clustering can be applied to employees having similar characteristics, grouping top performers, analysis of workforce attrition and segments related to retirement facilities, compensations, benefits, allowances. Data Mining also provides summary information: various multidimensional summary reports, statistical summary information (data central tendency and variation).One can use historical data to build models of fraudulent behavior and use Data Mining to help identify similar instances. Good research is done [52] [38] [1][14][12] with respect to Data Mining in machine learning and large data sets.

EFFECTIVE HRIS USING DATA MINING.

In a global competitive world, the loss of an employee or an under-performing team of employees may literally make the difference between success and failure. With these circumstances, it is no wonder that top management has needed more and more information from their Human Resource departments. They demand hard data, information on turnover, hiring, comparisons of compensation and benefits, ethnic, gender and cultural distributions [13].

One can access aggregate reports on position vacancies, salary patterns, performance details, etc. Organization can identify the overall training budget if it wants to know what kind of impact it is having on the company. Data Mining can identify patterns of successful employees who have participated in the training programs, their further progress after training programs, their work performance, their promotions and progress after training programs etc. The generated patterns will be crucial to further training investments for the employees. [29] Mentioned the concept of HR analytics. Data Mining tools focus on [29] historic data and report past events, attempt to focus on trend forecasting in order to highlight areas requiring management attention. Such an approach can be very powerful when combined with a balanced scorecard approach to defining and monitoring key performance indicators in HR, although there is a significant overhead in setting up and maintaining such tools.

Researchers have shown that there is much significant relationship between employee attitude and employee performance [16] [44] [48] mentioned that in today's competitive environment where it is necessary for organizations to have effective HRM practices, the HRIS can support the recruiting, selection and training efforts of the organizations as well as monitor who is leaving the organization and for what reason. Data Mining can identify which segments groups are most successful, which offices and locations have responded to training well, which employee responds to what training etc. it is more economical to retain an existing employee than to acquire a new one. To develop effective employee retention programs it is vital to analyze the reasons for employee attritions.

For example, usually the impact(s) of a change, a training program or a pay increase for a group of employees have historically been projected is always based on educated opinion and not on statistical benchmarks. Often, these opinions turn out to be wrong. When that happens, significant investment has been made with no resulting benefit to the corporation. Newly trained workers may leave to join the competition. A pay increase may have no effect on turnover. To respond to the new demands and the increased visibility of HR management, HRIS seeks a strategic role by turning to Data Mining methods.

Another important factor to consider in the Data Mining process is interpretation of questionnaires pertaining to qualitative data of employees. For example, a pattern may be detected using Data Mining tool pertaining to an employee having the highest compensation level and extended long length of service. The interpretation may be different. Can we conclude that if employees stay long they will have higher compensation or they stay longer only for higher package? Domain knowledge is required along with expertise to interpret the cause and effects of the relationships generated by these patterns. As each company has its own HR data, the interesting relationships in patterns depends the company's competing market, growth cycle stage, integration of various HR applications etc.

We can build a model that identifies employees and their characteristics, who are frequently, been involved in particular, work assignments and tasks. There are some decisions that involve mathematical modeling and analysis which the management must take. Like, what is the proper size of the labor force in a large manufacturing organization? How many people should be hired to handle a significant new influx of demand or a large new contract? This involves mathematically rigorous conviction because the factors that influence productivity are usually not known very well. A properly designed analytical and mathematical model, using appropriate sufficient data could help managers to make better decisions about the level of human resources needed in a market characterized by significant changes in demand. Figure.no.1 shows how raw data in any organization transforms into optimized strategic business decision. The information process scenario is true to any HRIS. Rule based what-if scenarios, forecasting techniques based on analytical data can be applied to HRIS modules.

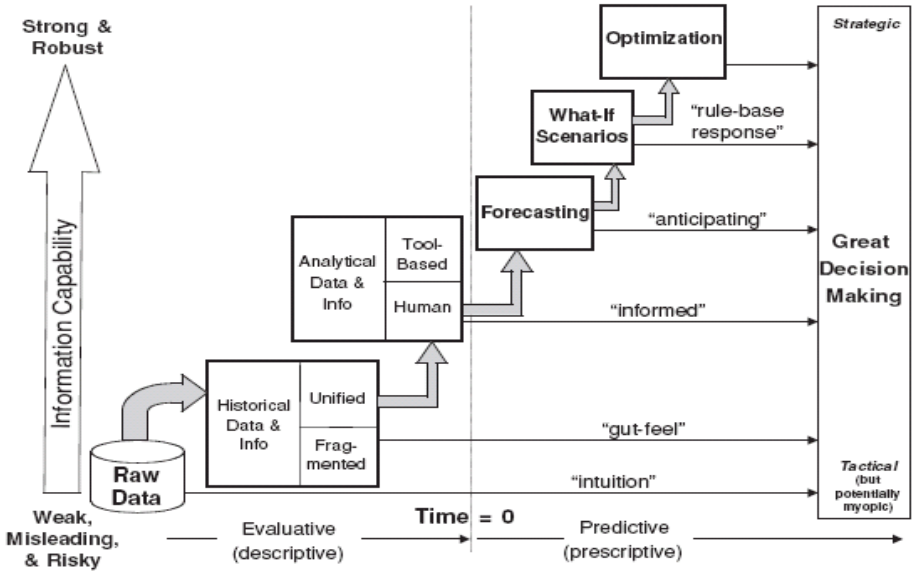

Fig.1 Data transformation into optimized business decisions (adopted from Cokins Gary (2004).

An important innovation within the human resources management (HRM) function is the use of information technology (IT), which has led to the development of computer-based human resources information system (HRIS). In fact, HRIS is the backbone of contemporary HRM function [27]. A HRIS is used to acquire, store, manipulate, analyze, retrieve and distribute pertinent information regarding an organization's human resources. Table 1.0 describes the difference between data, information and patterns of information that can be studied in an organization. The information capability based on know what, know how and know why is also provided.

	Process	Data	HR Reports	Training data	Employee Data
	Processing information in HRIS	**Information**	specializations data cross classified by training name, by employee name, by year	Training data cross classified by year, by course, by research project, by top performance.	Employee data-cross classified by top performance , training undertaken by year.
		Patterns of information using Data Mining	data showing interesting relationships or out of control categories; showing effectiveness in these data;	data showing interesting relationships or out of control categories; showing effectiveness in these data;	data showing interesting relationships or out of control categories; showing effectiveness in these data;
		Know-what	Ability to respond to a query; ability to assess symptoms of courses cancelled, correlations using statistics; identifying the best and popular training programs	Ability to respond to a query; ability to assess symptoms of training based on performance; correlations using statistics; identifying the best practices using expert systems.	Ability to respond to a query; ability to assess symptoms of employee' performance; correlations using statistics.
		Know-how	Ability to diagnose, analyze complex relationships using expert systems, Multi variate analysis of Variance using Statistics	Ability to diagnose employee attrition, analyze complex relationships using expert systems, Multi variate analysis of Variance using Statistics. Build competency and performance measurements tools.	Ability to diagnose students failures; Multi variate analysis of Variance using Statistics
		Know-why	Analysis of New programs, new employees , interdisciplinary work and thrust areas.	Employee communities of practice, personal assistance, group support systems, conference/seminars for sharing information.	Ability to deal with anomalies, interactive effects; use intranet based group support systems for assignments seminars, webminars and video conferences

Table 1.0 Representation of data and patterns of information in HRIS.

The power of data mining component, the robust analytical intelligence, is now available to business users in a compelling, easy-to-use format that is integrated with users' normal workflow. Feedback from analytics leads to corrective actions that positively impact business operations. Feedback guides decision-making, leading to actions that improve business performance. Rather than just reporting data, data mining HRIS introduces forecasting, modeling, and optimization capabilities for decision support. Analytics do not change the way people do business—they enhance how they do it. Data Mining tools are deployable across all levels of an enterprise, from top to bottom, and can be applied immediately to specific day-to-day business issues, such as with a customer call center, where information about each customer (e.g., account balance)

should ideally not only be current in real time but also suggestive of what action to take and why. The data mining tools deliver key metrics and precisely tailored information directly to casual users and decision makers. While enterprises will increasingly require these tools, complementing these capabilities with Data Mining applications substantially increases the overall value of their enterprise information and drives both sizeable productivity improvements across functional areas as well as profitable revenue enhancement. The primary goal of data mining in HRIS is to meld analytics with management functions so that data mining become an integral part of how managers and employee teams perform their job. Hence, successful implementation of data mining tools needs to focus first on specific business needs (i.e., supply chain management, customer churn detection and reduction, etc.).

CONCLUSION

In this paper, I have presented an interpretive perspective of techniques of Data Mining in HRIS by which organizations make sense of their vital HR data. I have also described Data Mining techniques with respect to HRIS. Organizations need to use HR data for strategic effectiveness. Data mining transform HR data into useful information and patterns to achieve competitive advantage. Careful and proper consideration and preparation of HR database, applying Data Mining Techniques will create an opportunity for firms to develop their competitiveness and effective decision making. I studied through Data Mining methods, once can measure the individual transactions and factors influencing an employee. Not all HRIS provide [24] integrated analytic features needed for compensation planning and decision support, such as the ability to also see related real-time competitive market salaries. Instead, they focus on database administration and record keeping related to compensation activities such as payroll, merit pay increases, and benefit enrollment. Migration and effective use of web-enabled integrated compensation design and analysis capabilities are still in their infancy [24]. The use of analytical HR software in all enterprises worldwide is very few.

We conclude that Data Mining on HRIS gives a better understanding of employee relations and improved employee satisfaction and higher probability of attaining competitive advantage. As the technology and techniques of Data Mining advance, organizations are able to collect, store, process, analyze and distribute an ever-increasing amount of HR data. Data and information are rampant in HRIS, but knowledge is scarce. As a result, most organizations today are governed by managerial intuition and historical reporting. However, we believe organizations are slowly moving to the knowledge age, where decision makers will leverage Data Mining technologies to augment intuition in order to allocate scarce enterprise resources for optimal performance. With proper preparation and consideration, HR databases together with data mining create an opportunity for organizations to develop competitive advantage.

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APPLICATION OF ENVIRONMENTAL CRITERIA IN ORGANIZATIONS ASSESSMENT WITH AHP METHOD

Dr Agnieszka Leszczynska, Maria Sklodowska Curie University, Poland
leszczynski1@poczta.wp.pl

ABSTRACT

An imperative to protect the environment leads to changes in the manner of activity and in the evaluation of a company. The results of the pro-environmental management of companies include green supply chains. Their effectiveness depends on the choice of particular links of a chain, considering not only efficiency indicators, costs, but also indicators concerning environmental management. The paper proposes the environmental criteria that may be used to evaluate companies and their products. Next, the procedure of expert assessment of companies using AHP method is presented. The evaluation is based on the general and particular environmental criteria, selected by a decision-making company from the group suggested by the author.

Keywords: environmental criteria, supplier assessment, AHP

"Traditional" measures of supply chain assessment

Increasing competition makes companies look for development opportunities by improving the management of supply chain both inside a company and along the line of contact of a company with its environment. Changes in a company management are oriented towards control and monitoring of the connections with outside partners, openness in cooperation, and synchronization of production processes, cooperative connections and market mechanisms (Piątkowski, Sankowski, 2005). A particular emphasis is placed on the development of effective connections, i. e. companies analyze costs they incur and effects of every activity in the chain generating value for a client, and strive to make possible improvements to increase profits. The result of such an approach is comprehensive assessment of cooperating companies.

According to the "traditional" approach, evaluation of cooperation partners is based on the logistic indicators representing empirically observable and measurable states of affairs which as adequately as possible describe the logistics aim or the aim system (Twaróg, 2003). These indicators are usually used to set aims and evaluate their implementation; however, they may also be applied in evaluation of the current data in order to monitor changes, play an advisory and control role (Kowalska, 1998). The traditional logistic measures can be most generally

divided into: the measures to assess the completion of a logistic process in the consecutive logistic chains, and the costs of logistic including:

- the measures to assess the efficiency of logistic activities (according to the flow stages),
- the measures of a company's own and external supply services,
- the measures to assess the duration of logistic activities in consecutive logistic chains.

The most popular of them include:

- price of a purchased product/service,
- product quality, supply quality,
- transfer time (time of delivery),
- punctuality of delivery,
- size of a maximum one-time lot,
- costs of transport, order handling, packaging,
- reliability and regularity of connections,
- scale of wastage,
- possibility to minimize the stored stock, e. g. using JIT,
- variability in time (flexibility of supplies),
- reliability of a supplier determined on the basis of one's own or others' experience,

financial condition of a supplier.

Because companies are characterized by specific requirements, expectations and preferences, the applied criteria undergo further internal differentiation (Bykowski, 1999). The comparison of offers is based on the scale methods, graphic methods.

The criteria mentioned above are used to assess potential cooperation partners and rationalize current activities in the area of logistics. The aim here is, first of all, to reduce costs, e.g. by adjusting the flow of materials along the logistic chain, and to increase the client's benefit, e.g. by increasing precision of delivery or reduction of transaction costs. These measures are thus supposed to be the basis in a decision-making process; they should provide companies with adequate sets of information needed to increase their competitiveness.

The criticism of traditional logistic measures and indicators follows from the fact that such measures are not strategic in character, and the connection between short-term measures and long-term results is not sufficiently clear. Moreover, most measurement systems are inflexible and do not take into account changes occurring in companies and their environment. This concerns also green supply chains whose development requires redesigned or completed system of traditional logistic measures. The next paragraph presents the concept of green supply chains. First, a set of environmental criteria that may be used in the supply chain management was presented, followed by a proposal of a possible application in economic practice.

Green supply chains

The development of the concept of sustainable development and increasing environmental requirements made ecological issues an essential component of contemporary companies management. This applies also to the function of logistics which includes establishing and development of green supply chains. Generally speaking, the concept of green supply chains is an organizational philosophy to make profit and reach market goals by reducing the environmental risk and impact and by improving the ecological effectiveness of a company and its partners (Zhu, Saris, Lai, 2008). Its gist is to incorporate the component of "greenness" into the traditionally understood supply chain, including provision, production and distribution. A broader understanding of the concept includes also product design and liquidation. Thus, the range of green supply chains encompasses designing environmentally friendly products, production using clean technologies, environmentally friendly packaging and transport, adequate procedures of product liquidation (remaking, recycling), etc.

The essential goal of green supply chains is a shared responsibility of cooperating companies for environmental results. Therefore, their participants promote reducing an impact on the environment by their own company and their partners. As a result, it is possible: 1) to reduce costs/benefits of environment-related activities, 2) to determine possible ways of reducing waste, 3) to reduce or eliminate waste inside a company (Handfield et al., 2002). Application of the concept of green supply chains to selected internal functions may also lead to: 1) using environment-friendly materials, 2) modernization of production process to make it cleaner, 3) ecolabelling, 4) ecological improvement of packaging and transport processes. An effect of such activities is an increase in the environmental results of a company, reduction of the risk of incompatibility with regulations and of environmental fines.

An assessment of suppliers by a company from the vantage point of the activity ecologization consists in making sure of the fact that materials and products suppliers provide are environmentally friendly and produced in the environment-friendly processes. Thus two main directions of "greening" the supply chain are related to evaluation of the environmental results and activities of suppliers and the latter's commitment to their improvement. The first direction consists in selection of criteria to assess suppliers (at the moment of evaluation). Another direction surpasses the routine assessment and monitoring, and consists in giving support to educational programs, creating environmental teams, implementation of environmental systems. The range of implementation of the green chain concept depends on the way it is perceived (it may be limited to a company's environment or incorporated into its internal functions) and on the level of ecological commitment of the company (on whether a company shows a pro-active approach to environmental management).

Environmental criteria of the company assessment

The main problem accompanying the development of green supply chains is determination of indicators to assess individual links of the chain. The logistic indicators described above, used in evaluation of the effectiveness of companies' logistic activities, do not provide sufficient information on environmental activities undertaken by companies, their environmental results, etc. Therefore, basing exclusively on the traditional logistic measures and indicators seems to a large extent insufficient in the case of green supply chains. Simultaneously, the research shows that one of the biggest problems encountered in the supplier evaluation and selection was which metrics to use to evaluate "greenness" (Handfield et al., 2002).

A solution to the above problem is to use the indicators related to environmental results, such as: the cost of environmental fees, CO_2 emission level, fuel consumption, water consumption, dangerous waste etc. This approach – no doubt the simplest – is based on the quantitative criteria. However, these measures were not always the most important metrics in terms of their impact on the environment.

Extending the group of criteria related to environmental results makes it necessary to include also the qualitative criteria in the evaluation process. This is a consequence of a multidisciplinary character of the environmental management concept, of the need to assess the effectiveness of logistic processes, both statically and dynamically, and also to evaluate the quality of services provided by business partners. Therefore, this paper proposes the multicriteria evaluation of suppliers on the basis of two groups of ecological criteria: 1) related to a company, 2) related to a product (Fig. 1).

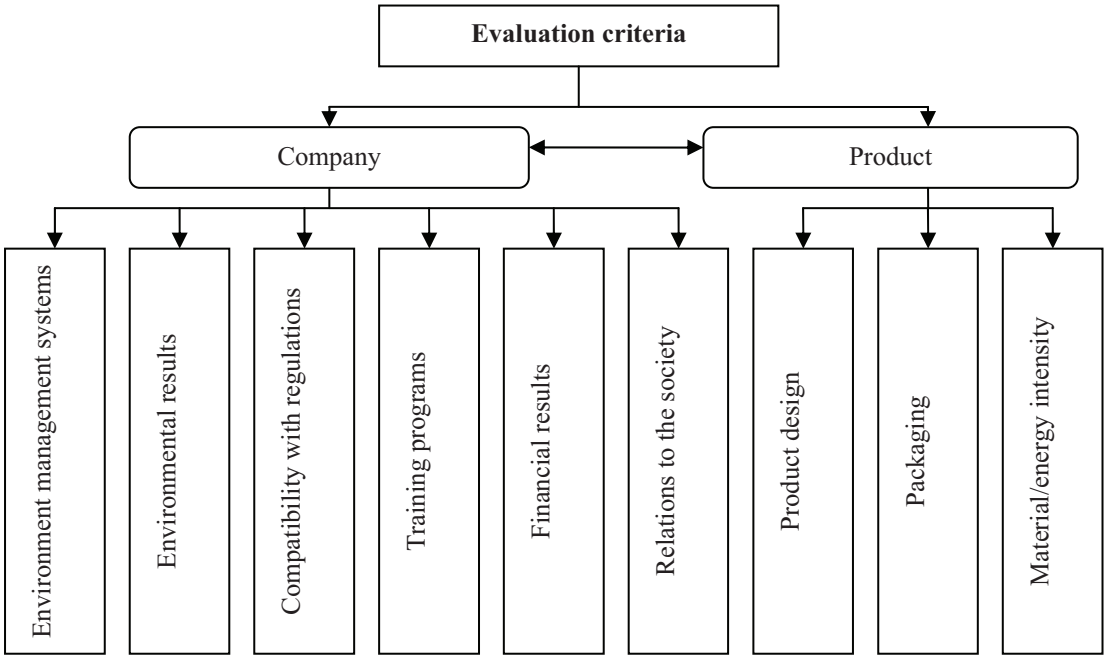

Fig.1. The proposed categories for environmental evaluation (Leszczynska, 2008)

The environmental evaluation of a company depends on the level of its "greenness", and covers: training programs, compatibility with regulation requirements, environment management systems, environmental results, financial results, and relations to the society. The assessment of products concerns the level of the product "greenness" and is determined by product design, packaging of the product, material/energy intensity; the number of categories may increase. The indicators used in each category are presented in Table 1.

Tab.1. The characteristic of environmental categories

Category	Description	Examples of the indicators
Environmental results	The category indicates the emission level, the size of generated waste and the range of use of natural resources.	Energy consumption Water consumption Quantity of waste
Environment management systems, environmental programs	The category refers to the extent to which the supplier's processes has been certified by the third party in the form of systems, i. e. ISO 14000, EMAS, and programs, goals and tasks related to the environment protection.	The scope of implementation of the environment management system The number of implemented pollution preventing initiatives The number of management levels with a definite environmental responsibility
Compatibility with the regulations	The category evaluates the extent to which the supplier's activities comply with environmental regulations (laws).	The time of reaction to environmental incidents Number of/ costs related to environmental fines, penalties
Training programs	The category focuses on the implementation of training programs related to environmental protection.	The number of hours of employee training on the advantages of …
Financial results	The category includes financial results related to the environmental aspects and activities of the company.	The costs related to environmental activities Return on capital invested in environment-improving initiatives
Relations to the society	The category determines involvement in the local environmental activities and contacts with the society/media	The number of enquires, commentaries on environmental issues The number of publications on the results of the company's environmental activity
Product design	The category determines the level of the supplier's involvement in designing environment-friendly products and in redesigning the existing products to eliminate the use of dangerous materials, or to meet the expectations of the so called „green clients".	The number of products planned for dismantling, recycling The number of products with instructions for environmentally safe use
Packaging	The category focuses on pro-environmental packaging, i. e. returnable, recycled, reusable packaging.	The share of recoverable secondary materials in protective elements
Material/energy intensity	The category determines the quantity of necessary materials (energy), including pro-environmental materials (i.e. recycled) in the production process.	% of materials coming from renewable resources in total materials Energy used per product unit

The criteria (indicators) used to evaluate cooperating companies may depend on the level of environment management in the company, on the goals of evaluation (decision-making process, obligatory documentation). For example, a company using the reactive strategy based on compatibility should focus on the indicators related to the degree of compatibility with legal requirements. On the other hand, a company adopting an innovative environmental strategy should take into account all the proposed categories. Moreover, the choice of logistic measures adequate for a given company should guarantee that they fulfill their proper function (advisory and/or operative). Therefore, the evaluation of a supply chain links on the basis of environmental criteria should be preceded by an analysis of the indicators referring to: the scope of tasks to be implemented, number and processing capacity, costs, etc.

The evaluation of supplier performance with AHP method

AHP method (*Analytical Hierarchy Process*) combines purely subjective expert evaluations with the objective analysis of decisions concerning hierarchically organized partial relations and connections among factors describing an analyzed problem. The method derives from the views of Saaty (Saaty, 1990) on the role of subjective evaluations, opinions in decision making. The subjectivity leads to ascribing different weights to partial parameters of each variant, which results in diversification of evaluation criteria. In this aspect, the method is analogous to the utility function (Kubiesz et al., 2008). In AHP method, decisions are analyzed in the framework of comparative or diagnostic evaluation, which leads to computation of the priority vector for the decision set or to application of the utility function the value of which is the basis for assessing dissimilarity of an analyzed problem. Thus the method adopts the multicriteria approach, based on the compensation strategy in preference modeling and assuming the comparability of variants, it takes into account the specific character of psychological processes of hierarchical and relational evaluation. Simultaneously, the method supports articulation of a decision maker's preferences and their use in the process of assessments aggregation. Modeling is used when unequivocal functional relationships among the problem components are not known and when the problem is described by a hierarchical structure of factors (criteria).
The evaluation of variants of an analyzed problem leads to a synthesis of partial results of those variants, described by a hierarchical set of criteria. The basis of AHP method is a hierarchical structure of goals, where the overriding goal is at the top of the hierarchy. The intermediate goals (criteria) are expressed by respective criteria of a lower level. Thus the structure of the problem of company-supplier performance evaluation takes the following form (Fig. 2):

- overriding goal – evaluation of suppliers' performance according to environmental criteria. Evaluation is performed by a decision-making company. In the author's study, it was a medium-size company producing chemicals, fertilizers, ethanol, titanium white;

- main criteria – the criteria selected from the group of the proposed environmental categories; seven criteria used in this study are presented in Table 2;
- partial criteria – the indicators chosen to evaluate the main criteria; the indicators used in this study are listed in Table 2;
- variants – the companies under evaluation. In this study: three companies (potential suppliers) active in chemical business.

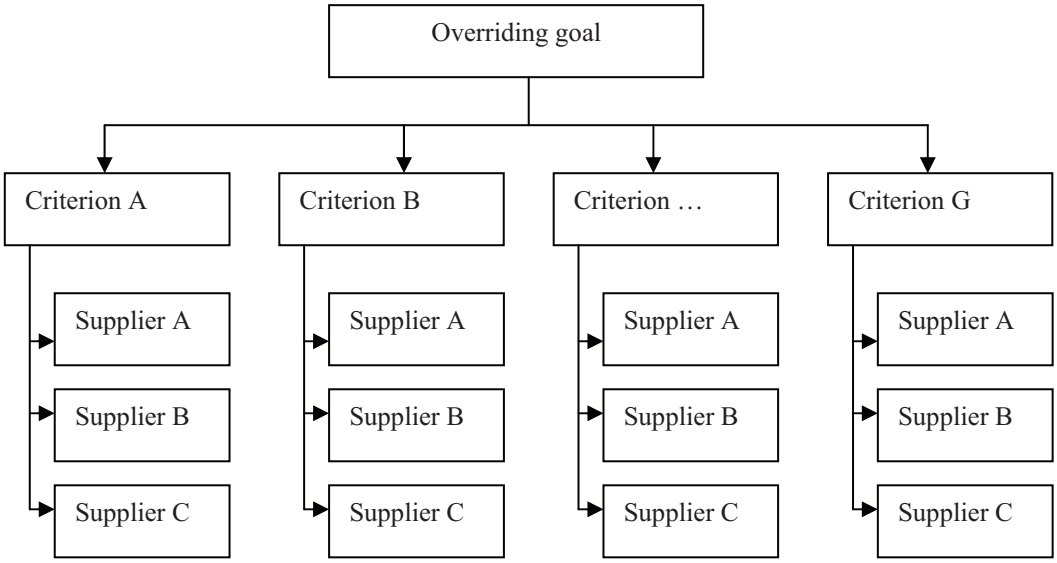

Fig. 2. Hierarchical structure of the problem

The procedure includes the comparison of all the factors in pairs to establish their mutual relationships. As a result, a matrix of subjective assessments is created, reflecting a degree to which a given company-supplier meets the relevant ecological criteria. The companies are evaluated on a conventional 1-7 scale.

Tab. 2. Criteria/indicators for evaluation of selected companies

Criterion	Indicators	Criterion symbol
Environmental results	Ammonium nitrogen, sulfates, COD, BOD_6, water consumption	A
Financial results	Environmental fees paid last year: water consumption, sewage disposal, emissions, waste storage	B
Environmental programs	Number of environmental programs planned for implementation in the next 3 years	C
Training programs	Number of employees trained last year in courses on ecological issues / general number of employees	D
Compatibility with regulations	Number of environmental audits performed last year	E
Relations with the society	Participation in pro-environmental initiatives in service of the society	F
Product design	Number of recyclable products/ general number of products	G

Analysis of the evaluation results

The analysis of the results was performed according to the specific AHP procedures. The first step was establishing, by the decision-making company, the relative importance of the selected criteria by evaluation of relationships between them, using the importance assessment technique. In this way, the matrix of comparisons for the degree of criteria preference was created on the basis of the company's preferences (Tab. 3).

Tab. 3. Matrix of the relative importance of the criteria

	A	B	C	D	E	F	G
A	1/1	7/1	2/1	5/1	3/1	2/1	5/1
B	1/7	1/1	1/5	3/1	1/3	5/1	5/1
C	½	5/1	1/1	5/1	5/1	3/1	3/1
D	1/5	1/3	1/5	1/1	2/1	1/5	1/7
E	1/3	3/1	1/5	½	1/1	1/5	1/5
F	½	1/5	1/3	5/1	5/1	1/1	2/1
G	1/5	1/5	1/3	7/1	5/1	½	1/1

The subsequent steps were the following:

- the relative importance of the criteria was decimalized,
- the square of the matrix was found,
- the values of elements of the new matrix were summed,
- the matrix of weights was found by sum normalization,
- consecutive iterations were performed on the basis of the above partial operations.

The weight vectors for the consecutive iterations of the performed operations are presented in Table 4.

Tab. 4. Results obtained for the selected criteria

Criterion	1st iteration	2nd iteration	3rd iteration	Order of criteria
A	0.297648	0.294767	0.296339	1
B	0.171752	0.140031	0.145734	3
C	0.232148	0.234428	0.234539	2
D	0.03294	0.039977	0.038389	7
E	0.067484	0.073089	0.072935	6
F	0.108947	0.117155	0.114516	4
G	0.08908	0.100553	0.097548	5

Next, the results obtained by each company-supplier for the selected indicators were collated (Tab. 5). The described procedure was used to determine the companies' preferences according to the criteria, and the number of criteria was reduced to the three most important: environmental results (1), environmental programs (2), financial results (3).

Tab. 5. Results of the suppliers for the selected environmental criteria

Index	Company A	Company B	Company C
Ammonium nitrogen [mg NH_4/l]	1.56	3.28	0.96
Sulfates [mg SO_4/l]	7.2	95.7	35.6
COD [mg O_2/l]	376.8	102.4	118.8

BOD_6 [mg O_2/l]	182.2	76.7	41.9
Water consumption [m^3]	4469917	128300540	57428933
Environmental fees [PLN]	56211234	33749916	48372391
% of trained employees	40	60	10
Number of planned environmental programs	8	5	1
Number of environmental audits	1	1	1
Participation in pro-ecological initiatives	2	1	1
Number of recyclable products [%]	33	60	33

Source: the author's own specification based on the information obtained from the companies.

The ranking of the preferred variants (companies) from the point of view of the individual criteria was put together on the basis of the computed (according to the previously described procedure) preference vectors (Tab. 6).

Tab. 6. Results of the generalized preferences

Environmental results	Environmental programs	Financial results
0.229505	0.64863	0.246801
0.121864	0.229505	0.436758
0.64863	0.121864	0.316441
2nd iteration	2nd iteration	1st iteration

The synthesis and interpretation of the solution is presented in Figure 3.

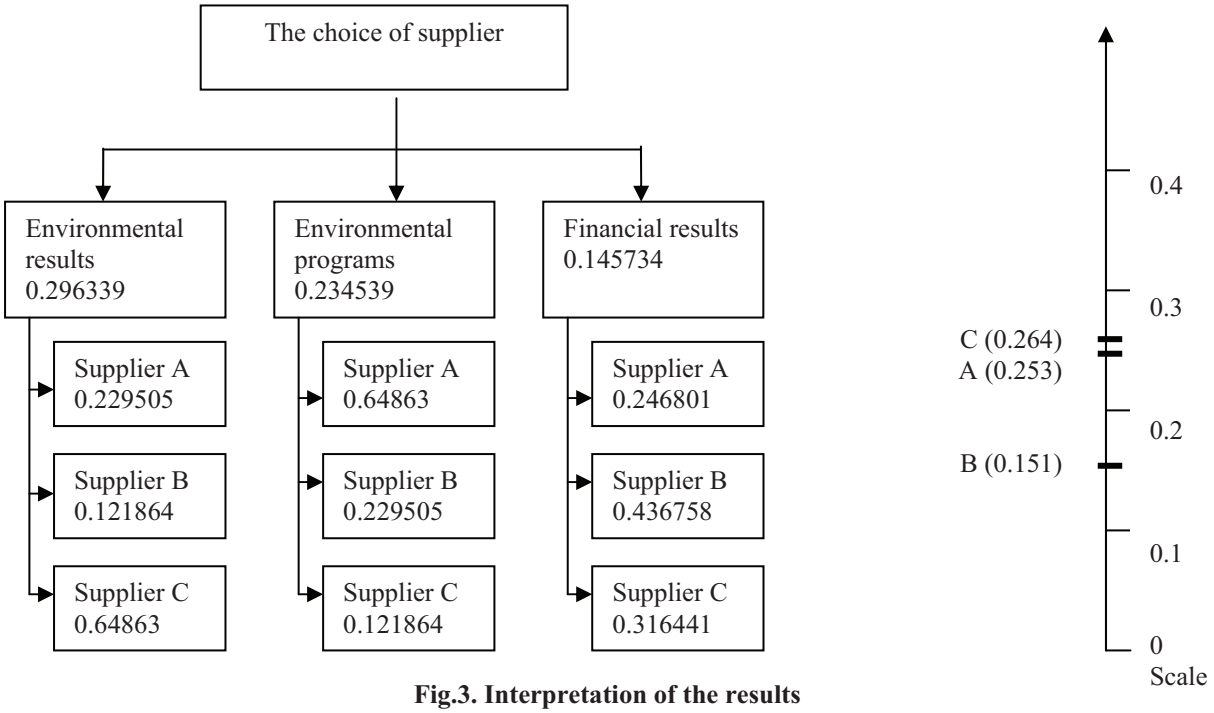

Fig.3. Interpretation of the results

CONCLUSION

The development of green supply chains results from a growing awareness and meaning of the environmental issues. Establishing of such chains entails the necessity of evaluation and

choice of suppliers who can proactively contribute to their company's environmental strategy and whose products and services meet or exceed government environmental regulations. This paper presented how the environmental measures/indicators can be used to evaluate links of green supply chains. The environmental criteria useful in evaluation of companies and products were proposed. The set of criteria may be extended by adding the logistic measures/criteria traditionally used by a company. Thus environmental indicators may be regarded as the ones complementing such "traditional" indicators as: proportion of orders accepted for realization, quality and time of delivery, flexibility of supplies, information openness etc.

The criteria presented in the paper were used to assess external suppliers. However, the presented indicators can also be used to evaluate a company's internal units. The identified indicators therefore satisfy the need for indicators that are useable both for an extended supply chain and for individual companies involved. The criteria were verified with AHP method, which was used to quantify the individual companies-suppliers.
Generalizing the study results, it should be stressed that the presented solution may be an efficient analytical tool in a decision process. This is due to the fact that AHP method makes it possible to determine the decision-maker preferences and to use them in the process of assessments aggregation. It may therefore be used in a multicriteria evaluation of cooperating companies on the basis of selected criteria.

A limitation of the presented solution is poor availability of the data. Resolving these types of issues is not an easy task. Much of the information needed for assessing environmental criteria is simply not available. In addition, companies are reluctant to give information on their internal activities. Other limitations result from the procedure of the AHP method application, and include a considerable subjectivism of judgments, necessity to meet the requirements of the method (e. g., possibility to perform operations on matrices).

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THE IMPACT OF ERP SYSTEMS ON INFORMATION FLOWS IN ENTERPRISES: A QUESTIONNAIRE SURVEY

Anders Haug, University of Southern Denmark, Denmark
adg@sam.sdu.dk
Anne Pedersen, University of Southern Denmark, Denmark
ape@sam.sdu.dk
Jan Stentoft Arlbjørn, University of Southern Denmark, Denmark
jar@sam.sdu.dk

ABSTRACT

The impact of ERP systems on the information flows of companies is an aspect often mentioned in ERP literature, but not a topic that has received much detailed attention. Based on existing ERP literature, this paper discusses the concept of ERP system integration in relation to how well the information flows in a company are organized around the ERP system. To investigate the level of ERP system integration in practice, the paper presents the data from a questionnaire study. The paper rests on the premise that ERP systems are designed as enterprise-wide repositories for master and transaction data, for which reason the intended utilization of an ERP system would imply that such companies are always capable of finding the necessary information when needed. However, data from the questionnaire indicates that this is not the case for many companies.

Keywords: Enterprise resource planning, ERP systems, Information flows, Information management

INTRODUCTION

Many companies have engaged in the use of ERP systems as a means to improve their competitiveness. Kumar et al. [16] describe the key underlying idea of ERP systems as "using information technology to achieve a capability to plan and integrate enterprise-wide resources, i.e. by integrating the applications and processes of the various functions such as design, production, purchasing, marketing, and finance". Basically, the popularity of ERP systems can be attributed to their promise of improving operational efficiency and business efficiency [8;13]. For many years, ERP projects have led to substantial tangible benefits (e.g. inventory reduction, less personnel needed, and reduced IT costs) and intangible improvements (e.g. improved internal processes, better customer service, strategic enhancements) in different areas of organizations [1;3;5;10;26]. On the other hand, achieving the expected benefits of the ERP system is by no means a guarantee in ERP projects. There are many examples of organizations that have not been successful in obtaining the intended benefits, in spite of making large investments in ERP projects [5;18;26]. Even worse, many ERP projects have failed and implied financial difficulties for these companies [20;28]. In fact, some research has indicated that ERP implementation projects commonly do not fulfil their initial objectives and operations often suffer from ERP related problems [11;17].

Although the implementation of an ERP system can produce significant performance benefits, achieving effective integration remains problematic because of the numerous technical and organizational challenges, such as the required standardization of work

processes, norms, skills, and outputs [2;12;15]. As formulated by Davenport [4], "an enterprise system, by its very nature, imposes its own logic on a company's strategy, organization, and culture". Because of the many built-in complexities in ERP projects, a significant amount of literature focuses on the management of ERP projects [11]. An important aspect in this context is redesigning the information flow structure of the company, i.e. defining how information processes should be altered to utilize the ERP system. The transition to using an ERP system (or extended use of an existing ERP system) affects the information flows in a company in a number of ways. From a principal perspective, the proper use of an ERP system as a common repository for enterprise data implies that relevant information can be retrieved by relevant persons. In other words, information flows should to a much greater extent pass through an enterprise-wide software system, rather than between individuals or groups in the form of oral messages, paper, emails, and local software systems. Guiding the information flows through a centralized and common channel ensures that information is always present when needed. This obviously implies a wide range of positive effects for a company, such as avoiding errors, shorter lead times, better basis for decision making, less redundant data, etc. Thus, such a transformation of the company appears to be something that should be a prioritized goal to any company. However, the question is if this actually is what happens in practice? Unfortunately, it seems that this topic is not something that has received much detailed attention in ERP literature [23]. Thus, this paper presents a questionnaire study carried out to investigate this question.

The remainder of the paper is organized as follows. Section 2 contains a review of relevant literature concerning the impact of ERP systems on the information flows of a company. Next, section 3 deals with the concept of ERP system integration. Hereafter, section 4 describes the method applied for investigating the impact of ERP systems in companies. Section 5 presents the empirical data from a questionnaire study, which are analysed and discussed. The paper ends with a conclusion in section 6.

LITERATURE REVIEW

This section investigates relevant literature in the context of analyzing the impact of ERP systems on the information flows of the company.

Effects of ERP systems on information flows

Mohania and Bhide [21] argue that the growth of organizations invariably leads to creation of multiple isolated data sources that are disconnected from each other, which leads to reduced efficiency. They further claim that the information integration problem has become the biggest pain point for enterprises today. Vayghan et al. [27] describe the concept of 'information silos', which means that data are redundantly stored, managed, and processed in different silos with different policies and processes. Thus, inconsistency often occurs. Vayghan et al. argue that enterprises need to move away from the 'information silo approach' and towards integrated management systems and architectures for data, processes, and policies.

ERP systems have been marketed as a panacea for dealing with lack of data integration, i.e. that replacing inadequately coordinated legacy systems by an ERP system should imply that most data quality problems would disappear [4;14;18]. However, it is important to perceive ERP as more than integration of IT systems, but to a great deal also business integration, i.e.

defining how the functional units of a company are linked to one another through data/information and processes. In other words, implementing an ERP system implies data and process integration. Organizational information processing theory suggests that ERP systems fit organisations where the interdependence is high and differentiation is low [8]. Thus, Gattiker and Goodhue [8] argue that there is a tendency towards organisational subunits that are highly interdependent to substantially benefit from an ERP system, while subunits that are very different from the other subunits may incur costs from dealing with suboptimal business processes or dependence on employee workarounds. The great danger of having a low fit between some organisational units and the ERP system is that such units use other software than the ERP system for some operations, and thus the purpose of information integration in the company is counteracted. To limit such negative impacts, the information flows of all relevant business units should be thought into the ERP solution.

One of the primary goals of managing the information flows in ERP projects is to ensure that the ERP system provides the needed data to relevant users and that data are of adequately high quality. In this context, Vayghan et al. [27] describes three important data-specific challenges: (1) establish trusted data sources; (2) integrate information; and (3) improve data quality. For the first challenge (establishing trusted data sources for enterprise-critical data), they argue that this becomes a major challenge if: the ownership of data is fragmented in many areas; there are multiple sources for the same data; existing data are undocumented and tightly coupled inside monolithic applications; and subject matter experts in these areas are in short supply. For the second challenge (problems of integrating information), they describe this as being caused by: platform dependencies; organizational issues; tight coupling with business processes; and the lack of business data standards. For the third challenge (improvements of data quality), they argue that this is increasingly difficult: when dealing with a large amount of data where data fields are not standardized; if there are multiple ways of capturing the same data; and if data is copied in many places.

The importance of information flow management

To highlight the importance of aligning the information flows of a company with their ERP system, this issue can be related to the type of benefits that an ERP system produces. Shang and Seddon [24] provide a classification of ERP benefits into five groups: 1) operational (cost reduction, cycle time reduction, productivity improvement, quality improvement, and customer services improvement); 2) managerial (better resource management, improved decision making and planning, and performance improvement); 3) strategic (supporting business growth, supporting business alliance, building business innovations, building cost leadership, generating product differentiation, and building external linkages); 4) IT infrastructure (building business flexibility, IT cost reduction, and increased IT infrastructure capability); and 5) organizational (supporting organizational changes, facilitating business learning, empowering, and building common visions). For all these types of benefits, the precondition is that the necessary information can be found in the ERP system. The more frequently information cannot be found, the less are the benefits of the ERP system.

Markus et al. [19] differentiate between three distinct phases in the ‘ERP experience cycle’: 1) project phase (configuration of ERP software and roll out in organization); 2) shakedown phase (the company makes a transition from 'go live' to normal operations); and 3) onward and upward phase (the company captures the majority of business benefits and plans future steps). In all three phases it is important to ensure that the information flows of the company

are aligned with the ERP system. However, the 'battle' is not lost if this alignment is not achieved instantly. Although the adequate alignment of the information flows with the ERP system is not achieved during the project phase, it can later be achieved during the shakedown phase. In the onward and upward phase, a focus on ensuring that healthy information processes are maintained is important in order not to lose the benefits obtained.
Another danger in ERP projects, besides not getting the required data/information into the ERP system, is that the data stored in the ERP system may be incorrect. Incorrect data is a problem that does not only affect the context in which they are used, but also may have much wider ranging consequences if data errors are carried throughout the system [9]. According to Häkkinen and Hilmola [11] marginal data inaccuracies (e.g. 1-5 percent) may not necessarily represent a major problem in manufacturing, but such inaccuracies will have direct effects in terms of lost sales and operational disruptions in the after-sales organizations. However, ensuring that the data stored in the ERP system is correct is an easy task. According to Knolmayer and Röthlin [14], capturing and processing master data involves several risks of errors, which can emerge from: inappropriate information system architectures, insufficient coordination with business processes, inadequate software implementations, or inattentive user behaviour. Knolmayer and Röthlin give the example that if an employee does not find required master data within reasonable time, the employee may be tempted to swiftly create duplicate data in order to continue his business tasks. Other common sources of errors, which may contribute to misunderstandings or data redundancy, are mistyping names, addresses, and other data fields.

ERP SYSTEM INTEGRATION

In literature there seems to be general agreement on the meanings of the terms 'data' and 'information', while the meaning of the term 'knowledge' is much debated (see e.g. [7;22;25]). However, in this paper the focus is on data and information. Davenport and Prusak [6] define data as "discrete, objective facts about events" and information as data transformed by the value-adding processes of contextualisation, categorisation, calculation, correction and condensation. Similar definitions of data and information are provided by Zack [29], "data represent observations or facts out of context, and therefore not directly meaningful. Information results from placing data within some meaningful context, often in the form of a message". In a similar vein, Newell et al. [22] define data as "providing a record of signs and observations collected from various sources" and information as when "data are presented in a particular way in relation to a particular context of action".

Much of the information passing through a company has relevance for others than the ones initially sending it and the ones receiving it. An ERP system can be the medium that ensures that such information is stored and made accessible to others. Therefore, an important focus of ERP projects is to force this communication of important information through the ERP system. To highlight the difference between structured and unstructured information flows, Figure 1 illustrates a scenario where structuralization of information flows implies that all relevant employees have access to the information they need. In the scenario on the left side of Figure 1, Actor-1 passes on information to Actor-2, while Actor-1 and Actor-2 fail to recognize that this information is also needed by Actor-3. In the scenario to the right, Actor-1 communicates to Actor-2 through an ERP system (i.e. stores data that Actor-2 finds), which enables Actor-3 to use this data as well. The type of data/information in focus in the described scenarios could be transaction data (e.g. invoice payment, receiving of ordered

items, etc.), master data (e.g. item name, debtor credit limit, etc.) or various business information (e.g. budgets, project plans, etc.).

Using the two scenarios illustrated in Figure 1, three archetypical information flow configurations can be defined with respect to ERP system integration, as shown in Figure 2. In Figure 2, the circles represent persons and groups, while the arrows represent communication of business information. As seen, the higher percentage of relevant information, which is exchanged through the ERP system, the more integrated the ERP system is. This measure indicates how well information is shared in an organisation, i.e. the higher the integration of the ERP system is, the greater the chance of being able to find needed information for the users of the system. Thus, 'full enterprise system integration' may at first glance seem to be the solution to all information problems. However, just because information is accessible, this does not mean that it is useful. The stored data also has to be of adequately high quality, i.e. correct, unambiguous, consistent, etc.

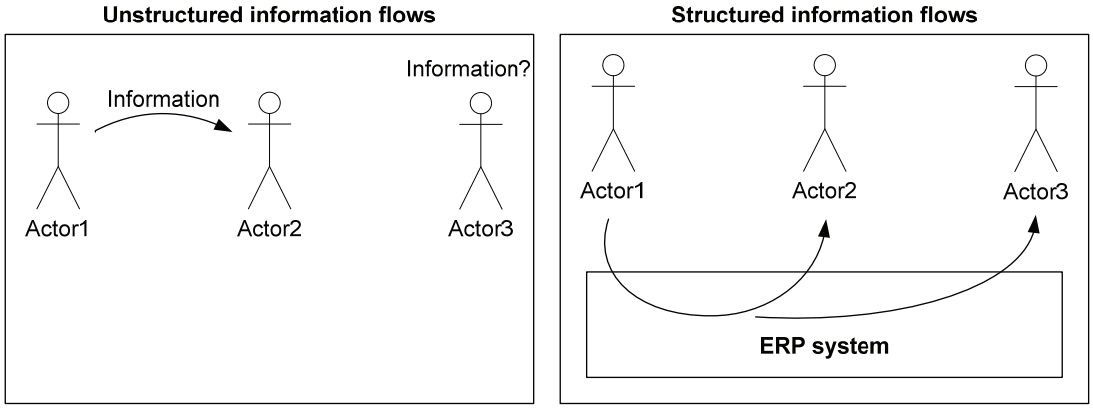

Figure 1: Unstructured vs. structured information flows

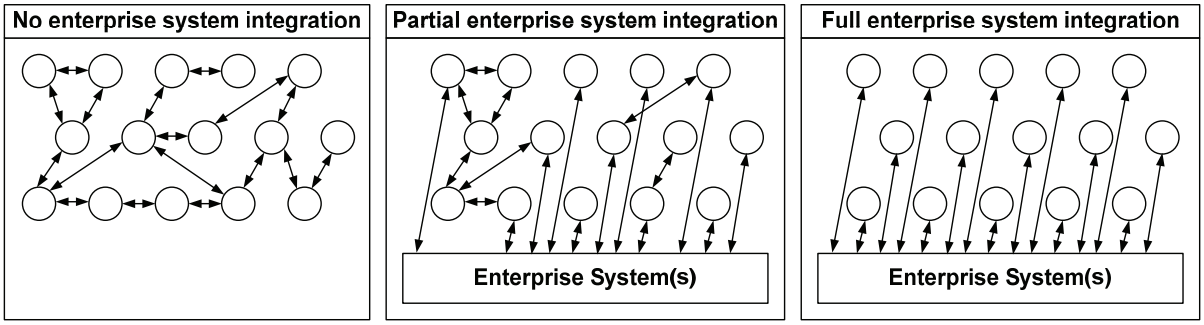

Figure 2: Levels of enterprise system integration (lines symbolize information flows)

RESEARCH METHOD

In 2008, a questionnaire study focusing on supply chain management was carried out. Part of the questionnaire had a focus on information systems within and across companies. The data from this part of the study are presented in this paper.

The questionnaire survey was conducted by distributing questionnaires to 110 of the participating companies at a Danish supply chain meeting ("The Supply Chain Day") arranged by the Danish post office "Post Danmark". This resulted in 49 completed questionnaires. The data were cleansed for companies not having an ERP system and for incomplete responses. This left 37 useable answers divided into 23 manufacturers, 10 wholesalers and 4 retailers. To be able to make a reasonable comparison of companies, it was decided to focus only on the companies of the type 'manufacturers'. This choice was made based on the assumption that such companies in general deal with greater challenges of data management because of dealing with both purchased/produced components and end-products. Table 1 shows the sizes of the remaining companies, divided into small companies (1-49), medium sized companies (50-249), and large companies (250 and more).

Size	1-49	50-249	250-	Total
Number	5	8	10	23

Table 1: Company sizes

RESULTS AND DISCUSSION

The questions about information management were organized into three areas, which are presented in the following sub-sections:

- Product development and production planning
- Deliveries from suppliers
- Deliveries to customers

Product development and production planning

To investigate the extent of the information management problems during product development and production planning, the respondents were asked to estimate how often needed information cannot be found and how often misunderstandings occur because of inconsistent information. Table 2 shows the frequency of needed information that cannot be found during product development and production planning and Table 3 shows the frequency of misunderstandings because of inconsistent information during product development and production.

Frequency/Company size	1-49	50-249	250-	Total
1. Never	20.0 %	12.5 %	20.0 %	17.4 %
2.	40.0 %	75.0 %	50.0 %	56.5 %
3.	40.0 %	12.5 %	30.0 %	26.1 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 2: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never	0.0 %	12.5 %	0.0 %	4.3 %
2.	100.0 %	37.5 %	60.0 %	60.9 %
3.	0.0 %	50.0 %	30.0 %	30.4 %
4.	0.0 %	0.0 %	10.0 %	4.3 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 3: Frequency of misunderstandings because of inconsistent information

The data show that for the majority of the companies, there do not seem to be great problems in relation to the handling of information during product development and production. In the dataset, 17.4 percent do not experience that information cannot be found, and 56.5 percent chose the rating '2'. For the remaining 26.1 percent who gave the frequency rating '3', the frequency of experiencing that information cannot be found cannot be considered satisfactory. A similar picture is shown from the frequency of misunderstandings occurring because of missing information, although happening a bit more frequently, i.e. 30.4 percent placed this at the frequency '3' and 4.3 percent at '4'. However, the problematic 26.1 percent in Table 2 and the 34.7 percent in Table 3 may be explained by other factors than just poor ERP system usage, since other systems often also are used together with an ERP system for the management of product and production information.

Deliveries from suppliers

To investigate the extent of the information management problems during the process of managing deliveries from suppliers, the respondents were asked to estimate how often needed information cannot be found and how often misunderstandings occur because of inconsistent information. Table 4 shows the frequency of that needed information cannot be found during the process of handling deliveries from suppliers, and Table 5 shows the misunderstandings because of inconsistent information during the management of deliveries from suppliers. In the questionnaires handed out, examples of the types of information in focus were included, i.e. amounts, quality descriptions, prices, item numbers and similar.

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	44.4 %	27.3 %
2.	80.0 %	75.0 %	33.3 %	59.1 %
3.	0.0 %	12.5 %	22.2 %	13.6 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 4: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	0.0 %	22.2 %	13.6 %
2.	40.0 %	87.5 %	44.4 %	59.1 %
3.	40.0 %	12.5 %	33.3 %	27.3 %
4.	0.0 %	0.0 %	0.0 %	0.0 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 5: Frequency of misunderstandings because of inconsistent information

The data show that 27.3 percent of the companies never experience that they cannot find the information needed during handling of deliveries from suppliers, while 59.1 percent rated this '2'. Only 13.6 percent experience not being able to find the needed information at a frequency of '3'. The frequency of misunderstandings because of inadequate information rated '3' is a bit higher, i.e. 27.3 percent. Therefore, the data show that it is only a smaller part of the companies which have problems during supplier handling. In these cases, however, there is a strong indication of unsatisfactory ERP system integration, since ERP systems are intended to hold all relevant information related to suppliers and purchases.

Deliveries to customers

Next, the extent of the information management problems during the process of managing deliveries to customers was investigated. In the context of management of deliveries to customers, Table 6 shows the frequency of lost information, Table 7 shows the misunderstandings because of inconsistent information and Table 8 shows the frequency of how often the delivery times are not kept because of inconsistent information. In the questionnaire handed out, examples of the types of information in focus were given, i.e. completed orders, ongoing orders, time of delivery, order size and similar.

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	0.0 %	20.0 %	13.0 %
2.	60.0 %	62.5 %	60.0 %	60.9 %
3.	20.0 %	12.5 %	10.0 %	13.0 %
4.	0.0 %	12.5 %	10.0 %	8.7 %
5. Very often	0.0 %	12.5 %	0.0 %	4.3 %

Table 6: Frequency of that needed information cannot be found

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	0.0 %	8.7 %
2.	60.0 %	50.0 %	70.0 %	60.9 %
3.	0.0 %	12.5 %	10.0 %	8.7 %
4.	20.0 %	25.0 %	20.0 %	21.7 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 7: Frequency of misunderstandings because of inconsistent information

Frequency/Company size	1-49	50-249	250-	Total
1. Never/almost never	20.0 %	12.5 %	10.0 %	13.0 %
2.	60.0 %	37.5 %	60.0 %	52.2 %
3.	20.0 %	25.0 %	10.0 %	17.4 %
4.	0.0 %	25.0 %	20.0 %	17.4 %
5. Very often	0.0 %	0.0 %	0.0 %	0.0 %

Table 8: Frequency of not keeping promised time of delivery because of inconsistent information

Table 6 shows that 13.0 percent never experience that they cannot find the information needed during handling of deliveries to customers, 60.9 percent gave the rating of '2', while 26 percent gave a rating from 3 to 5. In Table 7, 29.4 percent of the companies gave a rating from 3 to 5. Assuming that ratings of 3 to 5 are problematic, the data show that for more than a fourth of the companies there are problems in the handling of information related to deliveries to customers. With regard to being able to keep the promised time of delivery because of inconstant information, as seen in Table 8, for 17.4 percent this happens at a frequency of '3', and for 17.4 percent it happens at a frequency of '4'. The data from this part of the questionnaire indicate that these around 35 percent of the companies have unsatisfactory ERP system integration, since ERP systems are intended to hold all relevant information related to deliveries.

Information problems across processes

In order to show how many companies experience information problems in any of the three processes, in Table 9 is found a summation of the total number of the companies who in any

of the three processes (i.e. product development and production, deliveries from suppliers, and deliveries to customers) experience that needed information cannot be found.

Frequency of that needed information cannot be found in: product development and production; deliveries from suppliers; and/or deliveries to customers	Companies
1 Never	13,0.%
2	39.1 %
3	34.8 %
4	8.7 %
5 Very often	4.3 %

Table 9: Frequency of that needed information cannot be found in any of the processes

Assuming that ratings from 3 to 5 of how often the needed information cannot be found can be classified as being problematic, about half of the companies (48%) have information management problems in spite of having an ERP system.

Forms of communication

To investigate possible reasons for problems of managing information, the companies were asked to tell how often different forms of communication are used. Table 10 shows the way information is communicated during product development and production planning, and Table 11 shows the way information is communicated during the process of handling deliveries from suppliers.

Frequency of communication form	Email	Software	Printed documents	Handmade documents	Speech
1. Never	13.0 %	4.3 %	8.7 %	52.2 %	17.4 %
2.	13.0 %	8.7 %	30.4 %	21.7 %	26.1 %
3.	26.1 %	13.0 %	17.4 %	17.4 %	30.4 %
4.	17.4 %	17.4 %	26.1 %	8.7 %	17.4 %
5. Very often	30.4 %	56.5 %	17.4 %	0.0 %	8.7 %

Table 10: Product development and production planning: communication forms

Frequency of communication form	Email	Software	Printed documents	Handmade documents	Speech	EDI
1. Never	0.0 %	45.5 %	8.7 %	72.7 %	18.2 %	50.0 %
2.	0.0 %	18.2 %	30.4 %	18.2 %	9.1 %	9.1 %
3.	8.7 %	18.2 %	21.7 %	0.0 %	50.0 %	18.2 %
4.	21.7 %	9.1 %	34.8 %	4.5 %	13.6 %	22.7 %
5. Very often	69.6 %	9.1 %	4.3 %	4.5 %	9.1 %	0.0 %

Table 11: Deliveries from suppliers: communication forms

With regard to the way information is communicated during the product development and production process, the majority of the companies very often use software to handle this communication, i.e. 56.5 percent. However, the numbers also show that a significant part of this communication is in the form of printed documents, handmade documents and speech. These numbers provide a possible explanation to the problems reported with regard to not being able to find the needed information in this process. In the communication in connection with handling the deliveries from suppliers, email is by far the most used means of communication, i.e. 69.6 percent stated 'very often'. However, information is also to a large extent exchanged by speech, which may be part of the explanation for the amount of lost and inconsistent information reported.

CONCLUSIONS

In much literature ERP systems are described as a technology that promises integration of business information across the business units of a company. However, also much literature points out that this does far from always happen in practice. One of the main obstacles is that such a transformation requires great alterations of the information flows of the company to insure that information passes through the system and not past it. To deal with this topic, this paper discussed how ERP projects can transform the way that business information flows through a company. The paper presented three archetypes of enterprise system integration: 'no integration', 'partial integration', and 'full integration'. These types are relevant in the sense that the degree of ERP system integration in many ways is decisive for the amount of benefits that a company can achieve from an ERP project.
Having defined different levels of ERP system integration, a question to be raised is that although many companies manage to implement ERP systems into daily operations, do they actually achieve a satisfactory ERP system integration, i.e. a proper restructuring of the information flows within the company? To investigate this issue, the paper presented a questionnaire study from where the companies of the type 'manufacturer' and the ones that use ERP systems were selected, in all 23 companies. The data from these companies indicate that about half of these companies have problems in managing their business information, in spite of having an ERP system. However, the data from the conducted study should be received with some reservations. First, it should be recognized that the amount of data retrieved fitting the selection criteria (i.e. manufacturers with ERP systems) was not very extensive for a study of this kind. Therefore, the study does not give a solid basis for generalization about the quality of information management in Danish manufacturing companies with ERP systems. Another problem of the study is that the way the questions were asked left much to the judgement of the respondents. Also, since only one person from each company filled out the questionnaire, there is a great chance that others in the same organization may have insights into other problems of handling information. Thus, it seems fair to assume that the numbers would have been higher if more persons from each company had answered the questionnaire.

Since about half the companies in the survey reported not being able to find the relevant information at a frequency that seems unsatisfactory, there are some indications of problems related to ERP system integration. This produces two main challenges for future research. First, a more extensive survey needs to be carried out in order to produce better grounds for generalizing. Second, more in-depth studies are needed in order to discover the reasons for the apparent problems of integrating ERP systems in companies.

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EVALUATING PRODUCT-SERVICE SYSTEMS USING SYSTEM DYNAMICS

Ms. Sora Lee, Seoul National University, Korea
soralang@snu.ac.kr
Ms. Jieun Kim, Seoul National University, Korea
hsns1234@snu.ac.kr
Dr. Chulhyun Kim, Induk Institute of Technology, Korea
stddevs@induk.ac.kr
Dr. Yongtae Park, Seoul National University, Korea
ytpark@snu.ac.kr

ABSTRACT

Product-service systems (PSSs) are highlighted as prevailing trend toward integration of products and services for customer satisfaction or sustainability. Many firms have chosen PSSs as an essential strategy to survive in hyper-competition. However, few systematic methods for evaluating PSSs from multi-objective perspectives have been established. This study proposes a systematic approach to evaluation of PSSs using system dynamics from multi-objective perspectives such as customer satisfaction, sustainability, and profitability. System dynamics is a method developed to support the dynamic behavior in complex systems. It can be effectively employed in analyzing PSSs which are complex systems including many stakeholders and objectives interrelated with each other through product life cycle. The proposed approach deals with the properties of PSSs through the general steps of system dynamics simulation procedure. It enables firms who adopt PSSs not only to evaluate and compare alternatives but also to describe and understand the systems' mechanisms and feedback links. A simple case of PSSs providing washing function is presented for illustration of the proposed approach.

Keywords: Product-service system, System dynamics, Evaluation, Customer satisfaction, Profitability, Sustainability

INTRODUCTION

Nowadays, manufacturers are suffering from lack of strategies for satisfying customers. Their agony is how to differentiate them in tough competitive market. One of the new arrival as a solution for this problem is product-service systems (PSSs) (Matthyssens and Buyl, 2005; Baines et al., 2007). By integrating products with services and various enablers, PSSs add value for customers. Moreover, PSSs are focused on in an ecological aspect. By emphasizing the 'sale of use' rather than the 'sale of product', PSSs enable manufacturers to reduce and optimize the use of resources. Increasing concern about environmental effect of economic activities is highlighting PSS as imperative milestone to achieve sustainability (Baines et al., 2007). Therefore, many manufacturers are trying to adopt PSSs for their benefits.

However, there are many barriers to adoption of PSSs. Lack of methods and tools for designing PSSs exists at the core of difficulty. PSSs have distinguishable features from products obviously. PSSs involve dynamics of system including many stakeholders and

objectives that are inter-related each other. That is, PSSs incorporate somewhat complex aims which are minimization of environmental impacts while maintaining enterprises' economical performance and service quality for users (Komoto et al., 2005). These facts lead the needs for new systematic methods and tools for PSSs. As it is already mentioned, systematic methods for designing PSSs have, however, not yet fully established. This implies that there is a lack of methods and tools for concept evaluation of PSSs. Concept evaluation to identify the most promising design concept has been considered very critical as it has significant impact on the downstream development processes as well as on the success of the PSS developed (Zhai et al., 2009). Thus it is much important to establish systemic PSS concept evaluation methodology at the systemic level in practice.

This paper aims to propose an approach to evaluating concept of PSSs by simulating alternatives using system dynamics. System dynamics is a method which was developed to support the dynamic behavior in complex system. It can be effectively employed to analyzing PSSs which are complex systems including many stakeholders and objectives interrelated each other through product life cycle.

Remained of this paper is organized as follows. The basic concept and related studies on PSSs and system dynamics are discussed each in the following sections. After the proposed approach for evaluating PSSs using system dynamics is introduced in the next section, a simple case is presented for the illustration of the proposed approach. Finally, summary and further discussion concludes this paper.

PRODUCT-SERVICE SYSTEM

Product-service system (PSS) is a marketable set of products and services capable of jointly fulfilling user's needs (Goedkoop et al., 1999). The PSS concept aims at minimization of environmental impact with use of alternative production and consumption patterns. There are several definitions for PSS, but it has been generally described as 'a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models (Mont, 2002)'. At its core, PSS focuses on the delivery of a 'function' to the customer, instead of sale, ownership, consumption, and disposal of 'products' (Williams, 2006). Actually the approach is to substitute services for products and moving from 'product thinking' to 'system thinking' (Mont, 2003).

Within a traditional paradigm, the relationship between a producer and a consumer is quite simple (Williams, 2006). When the producer sells a product after designing and manufacturing, the consumer buys it. This is the end of producer's roll because the producer has given ownership to the consumer. In contrast, in PSSs, manufacturers' involvement and responsibility is extended from making a product available to purchase to phases of the life cycle that are usually outside the buyer-seller relationship. Therefore PSSs require close integration of all actors within the life cycle of products (Mont, 2002; Mont, 2003). The stakeholders in PSSs interact actively each other forming network, thus the relationships among them are likely to be complex.

This complexity can make firms difficult to design PSSs. In some cases, it will result in an additional cost for communication and a slower market introduction because of the difficulty in explaining (Goedkoop et al., 1999). Although various tools and methodologies have been

introduced for designing PSS (Mont, 2000; Goedkoop et al., 1999; Aurich et al., 2006; MEPSS Handbook, 2004; etc.), still there is lack of critical and in-depth evaluation of their performance in practice and need for in-depth and rigorous research to develop models, methods, and theories (Baines et al., 2007).

Especially, as concept evaluation to identify the most promising design concept has been considered very critical on the success of the PSS (Zhai et al., 2009), many related studies have been conducted. In the first place, some researchers mentioned about what to evaluate. Maxwell and Vorst (2003) identified nine criteria for optimizing PSS: functionality, environmental impact, social impact, economic impact, quality, market demand, customer requirements, technical feasibility, legislation and technical industry specifications. While Thoben et al. (2001) focused on economic impact, market, and customer because they asserted that the goals of PSSs are proposing an attractive package for the customer and standing out from competition, Bhamra et al. (2001) attended to environmental impact and social impact from asserting that PSS involves environmental considerations such as dematerialization and sustainable products.

Looking over studies aiming to propose specific methods or tools, we can identify the two critical factors that most of them are focusing on. The one is economic value based on customer satisfaction and the other is ecological effect based on product life cycle. Caswell et al. (2008) developed a computation model to estimate economic value of service system that could be aligned with PSSs by definition. The model takes into account partners' satisfaction and the additional value which is created by the relationships among the various partners. Tasaki et al. (2006) suggested a quantitative method to evaluate the level of material use and waste generation in lease/reuse systems, using a simple indicator in terms of annual product demand. As a consequence, whether a system shortens or extends the lifetime of products appeared to be the key factor to determining material intensity, not whether the system itself was a lease system or a possession system. Komoto et al. (2005) proposed a methodology to analyze PSS based on discrete event simulation technique. They described the resulting performance of product life cycle as a function of occurrence of the PSS-events and their individual performance.

Although various attempts to deal with evaluation of PSS, there still exist some limitations or problems. Little systematic approach to evaluate PSS from multi-objective perspectives is established. Interrelations among the objectives are scarcely considered even though multi-objectives are estimated. Moreover, they tend to oversimplify the complex systems not fully considering the characteristics of PSSs.

SYSTEM DYNAMICS

System dynamics is a methodology that was specifically developed to support the study of dynamic behavior in complex system. It draws on a wide variety of disciplines to provide a common foundation for understanding and influencing how things change over time. Its central concept is that all the objects in a system interact through causal relationships. System dynamics recognizes the roles of the feedback information and the cause-and effect relationships in creating the dynamic behaviors of the systems, and takes an integrative perspective in modeling the system (Rabelo et al., 2005).

System dynamics modeling is mainly about discovering and representing the feedback

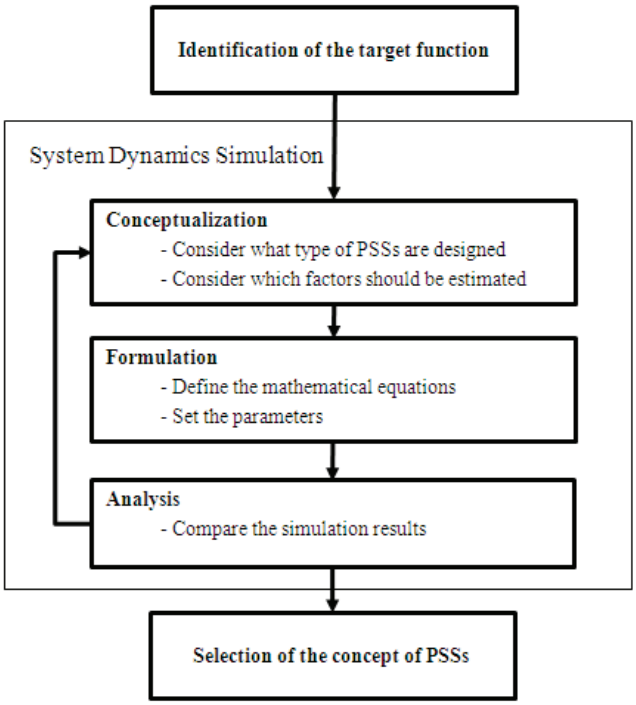
processes (Sterman, 2000; Hjorth and Bagheri, 2006). It determines the dynamics of a system along with stock and flow structures, time delays, and nonlinearities. As a result of these processes, causal loop diagram is drawn. Causal loop diagram is a powerful graphic tool to see the relationships among a system's parts and their interactions with each other. It is composed of a simple node-arrow construct that interlink key system variables by arrows indicating directions of causality. And a series of causal relationships consists of the set of interconnected feedback loops. While attempting to draw causal loop diagrams, we can enhance learning in complex system through not only a better understanding of a system's mechanisms and feedback links, but also modifying decision rules and mental models of the real world (Hjorth and Bagheri, 2006; Sterman, 2000). This has helped many managers to think how a strategy might or might not work, and what kind of consequences emerge. Finally, simulation models based on causal loop diagrams are built and run, which help to analyze system performance under different scenarios.

We found the possibility of system dynamics to be employed successfully in PSSs. As mentioned earlier, PSS is a large and complex system including many stakeholders and transactions. There are multiple driving forces such as customer satisfaction or sustainability, which have interdependence among each other. System dynamics approaches reasonable and actual solution by incorporating various interests and interactions of objects in complex system, and reflecting dynamic behavior. PSSs need long-term feedback during product life cycle. Although that is one of the main reasons many existing approaches cannot be employed to PSSs successfully, system dynamics can deal with this issue satisfactorily. System dynamics has been used in the business to evaluate the impact of business alternatives on the long-term performance of the enterprise (Rabelo et al., 2005). The fact that system dynamics is considered as a powerful methodology to deal with issues of sustainability (Hjorht and Bagheri, 2006) enhances the suitableness of system dynamics for PSSs.

In addition, designing PSSs is iterative process with restructuring business organization. Simulation technique deals with the repetitive tasks efficiently. As system dynamics does not depend on data and has been considered suitable for qualitative parameters in management decisions, it has more powerful in concept evaluation phase. Therefore, system dynamics enables the efficient and effective decision-making during the iteration of concept design process for PSS.

EVALUATING PRODUCT-SERVICE SYSTEMS

In this chapter, we briefly explain the procedure of evaluating PSSs to aid manufacturers to adopt PSSs. Following the general steps-conceptualization, formulation, and analysis-in system dynamics simulation process, we focus on the characteristics of PSSs. Figure 1 depicts the framework of proposed approach.



[Figure 1] Framework for evaluating PSSs concept using system dynamics

Based on the target function that would be offered to customers, manufacturers conceptualize their PSSs concepts. While manufacturers have delivered their offering to customers by selling their products traditionally, the offering is function in PSSs. The delivered form of function varies in integrating way of various service enablers. Generally, there are three types of PSS(Baines et al., 2007) as shown in Table 1. Depending on the PSS type, the stakeholders, their roles, and transactions in system are varied. Therefore, considering the delivering way of target function can be a good starting point for establishing variables to conceptualize PSSs.

[Table 1]Three types of PSS

Type	Description
Product-oriented PSS	promoting/selling the product in a traditional manner, while including in the original act of sale additional services such as after-sales service to guarantee functionality and durability of the product owned by the customer
Use-oriented PSS	selling the use or availability of a product that is not owned by the customer
Result-oriented PSS	selling a result or capability instead of a product

After deciding the delivering way for the target function, defined the estimated factors of the PSSs. As summarized in section 2, several critical factors for designing PSS were identified. Firms are able to consider some of them depending on their purposes. Generally, customer satisfaction and sustainability are considered as main objectives of PSS. And it is no wonder that economical benefit of firms is also included.

The important task in conceptualization step is lining the relationships among the established variables. The core of conceptualization of PSSs in system dynamics exists in finding how the critical factors are connected each other. The stakeholders make complex tangible and intangible transactions, and the critical factors are resulted in these transactions and additional variables. The variables and their relationships are represented in causal loop diagram.

The rough relationship depicted in conceptualization step is defined as mathematical form in formulation step. Many studies have proposed the calculation for each factor. Firms can apply or modify those proposed equations depending on their situation and purpose. Generally, customer satisfaction is calculated from perceived value and paid cost and profitability of firms is calculated from price and cost. In the case of sustainability, there exist various approaches to estimation. In practice, guidelines or regulations from committee or government approach are useful. And then, parameters for simulation are determined

Finally, the model is simulated. Results of each concept are analyzed and compared each other. If necessary, the simulation can be repeated based on several scenarios. As the dynamics of PSS range over product life cycle, change of environment should be fully considered. Additionally, finding uncovered feedback loop provides the opportunity for correcting their strategy and solving their problems. As a nutshell, the results of simulating PSS concepts imply some important insights that are hard to be provided from other approaches for firms. The application of this approach depends on the situation of firms in practice. In the next section, an example is presented for illustration of this approach.

ILLUSTRATIVE EXAMPLE

The proposed approach is applied to a washing machine manufacturer. The firm is faced the issue on whether it keeps the existing business model or not. Traditionally, the firm has sold washing machines to customers. The traditional business model seems that it cannot guarantee the growth of the firm any more. Therefore, new concept of business model as a PSS for providing washing function is proposed. In the new business model, washing function is provided to customers by guaranteeing accessibility to the washing machine owned and maintained by manufacturer. It is called ‘pay-per-use model’ and ‘use-oriented model’ in the classification of PSSs type.

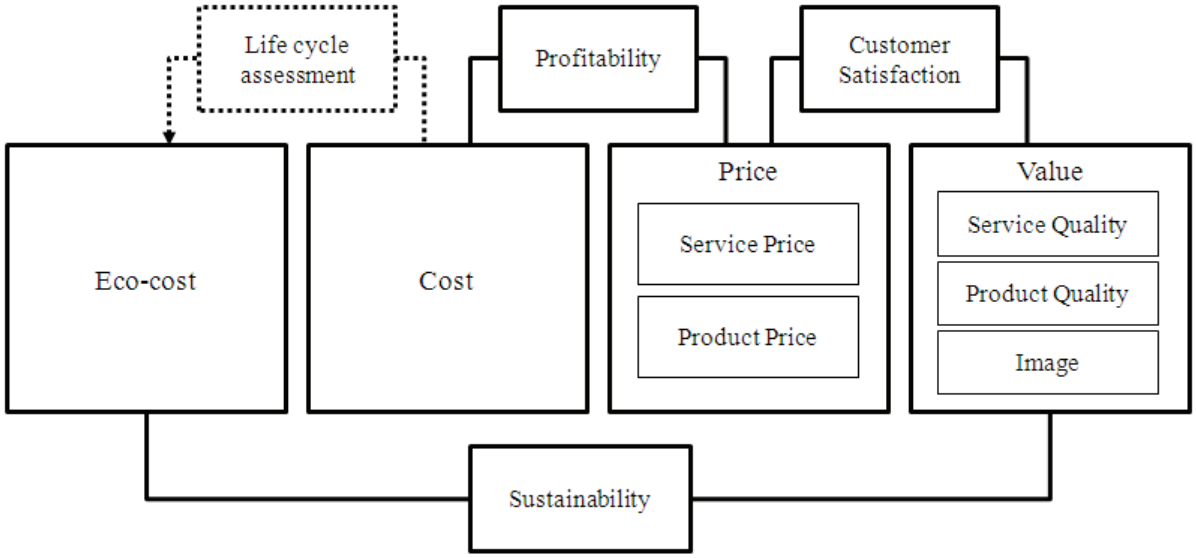
Roles and relevant stakeholders during product life cycle are depicted in table 2. Product model used in each concept is also different. While products in the traditional model are not reused, other products in the alternative would be reused by the manufacturer.

[Table 2] Example of role and responsible part for each concept

Concept		**Traditional model**	**Alternative**
Product model		Household	Community
Role	Manufacturer	Manufacturer	Manufacturer
	Owner	Customer	Manufacturer
	Operator	Customer	Customer
	Maintainer	Customer	Manufacturer

Disposer	Customer	Manufacturer
Reuser	-	Manufacturer

The firm is concerned about the profitability acquired from each PSS concept. Customer satisfaction and sustainability are also main factors to be estimated. Generally, customer satisfaction is considered as the basis of the profitability. In aspects of environment and pollution, government is tightening regulations. Moreover, eco-friendly firm gets more attractive to customers. Based on the physical transaction among the stakeholders, these key factors are estimated. After the variables comprehensively established, the relations among them are mapped. Figure 2, the strategic model for PSS, conceptually shows the relations among the variables.

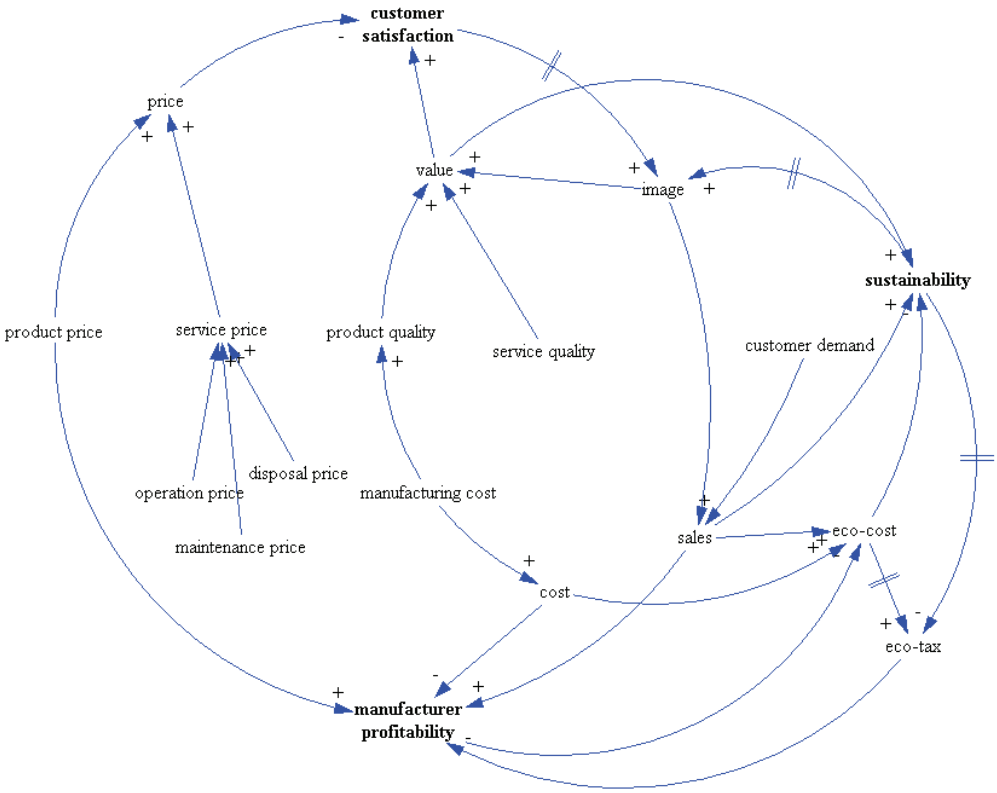


[Figure 2] Strategic model for PSS

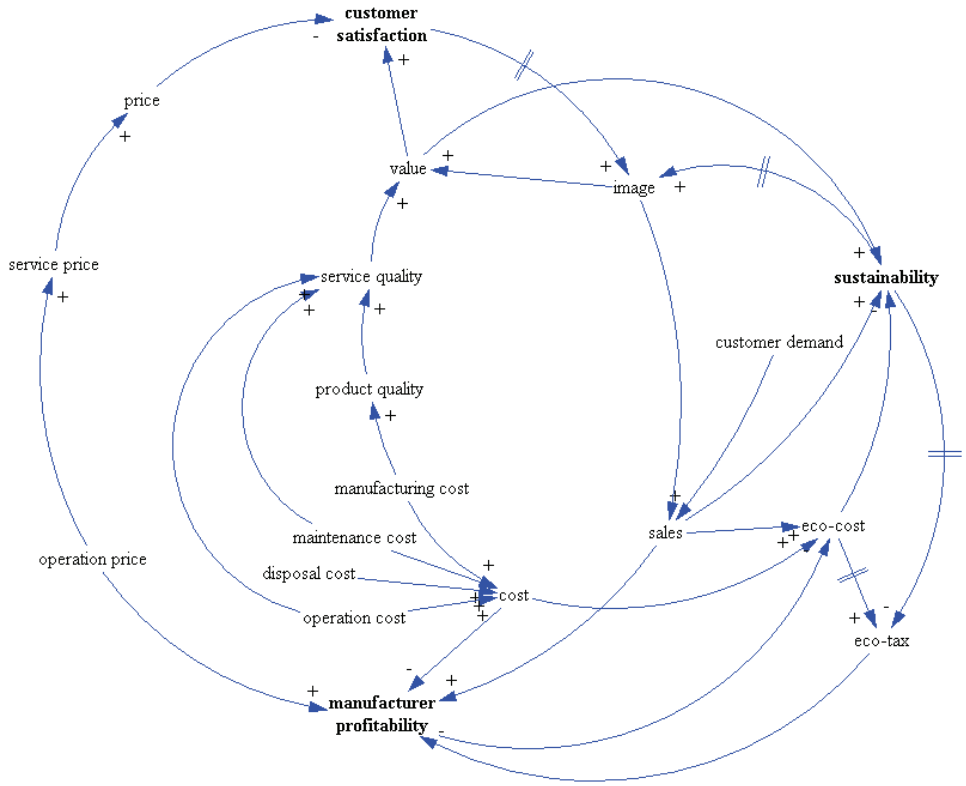
Figure 3 and figure 4 are causal loop diagrams based on the strategic model. While manufacturer get the product price in the traditional model, the operation fee is income of manufacturer in alternative. The service that has been traditionally provided by the third party is provided by manufacturer in alternative. Additionally, some different causal links are identified.

Completing the conceptualization of each model, the relation is formulated into mathematical equations and parameters are set for simulation. Customer's satisfaction is calculated with value divided by price. Manufacturer's profitability is basically calculated from the differences from price and cost. In practice, tax for environmental regulation is included in cost. In this simulation, however, the tax is subtracted from the price as a distinguished item for highlighting the relation between profitability and sustainability. To make this illustrative case to be simple, the equations related with environmental is supposed as very simple form. The tax is calculated based on the sustainability of the system. Sustainability in this simulation is estimated as eco-efficiency (Vogtländer et al., 2001). Eco-cost is proportional to cost. The simplification of mathematical equations in case study is not critical considering the

purpose of this case study and this paper. For each variable, the equation is specifically defined and parameter is set. The products' feature used for setting parameters is depicted in table 3.



[Figure 3] Causal loop diagram of traditional model

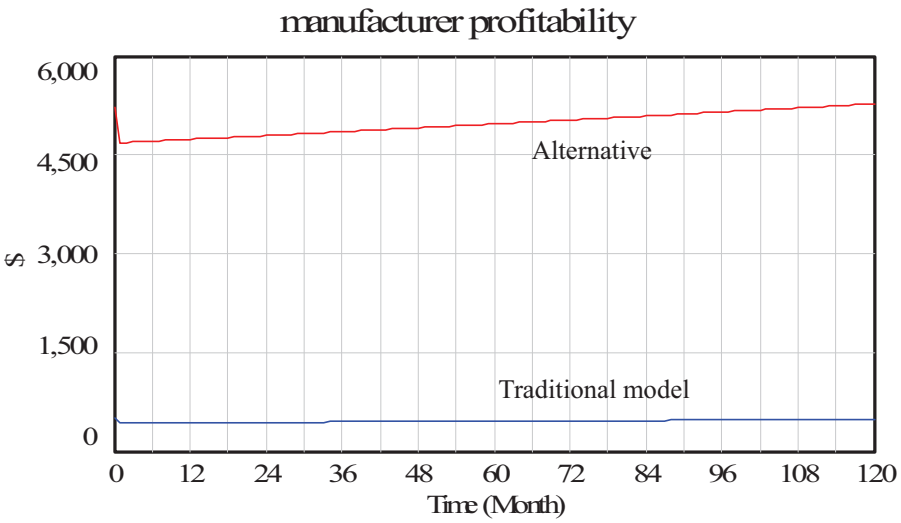


[Figure 4] Causal loop diagram of alternative 1

[Table 3] Feature of product for each model

	Traditional model	**Alternative**
Product type	Household	Community
Price [$]	500	1000
Life time [year]	10	5
Operation capacity [operation/week]	5	100
Capacity [kg/operation]	4	6
Failure rate [/operation]	0.0001	0.0001
Operation cost [$/operation]	0.2	0.3
Operation fee [$/operation]	0.2	0.3
Repair cost [$/failure]	100	100
Repair fee [$/failure]	100	150
Disposal cost [$]	25	25
Reusable	No	Yes
Reuse cost [$]	-	75

Results of the simulations show that level of customer satisfaction and sustainability in alternative are higher than those in traditional model. This leads the rapider increase in manufacturer profitability in alternative than the increase in traditional model shown in figure 5. That is, the performance of new business model is expected to be better than traditional model. Thus, the new PSS concept, ‘pay-per-use model’ is recommended to be adopted.



[Figure 5] Simulation result-manufacturer profitability

CONCULSION

This study proposes a simulation-based approach for evaluation of PSSs. PSSs are large and complex systems with multi-objectives that depend on each other. The proposed approach serves these distinguishable attributes of PSSs using system dynamics. The case of washing machine manufacturer was presented for illustration of the proposed approach. The illustrative case shows the possibility that proposed approach based on system dynamics can be successfully employed in modeling and analyzing PSSs. Analyzing more simulation results on customer satisfaction, sustainability, and other causal variables is listed as ongoing work. That would be more fruitful insights for manufacturers.

However, the refinement of proposed approach is still remained. Each step need to be more clarified and detailed. Further, more abundant and realistic case study is practically useful for lots of manufactures who try to adopt PSSs.

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THE STRUCTURAL IMPACT OF SUPPLY CHAIN MANAGEMENT ON PROCESS PERFORMANCE

Arawati Agus, Graduate School of Business, Universiti Kebangsaan Malaysia,
araa@pkrisc.cc.ukm.my
Za'faran Hassan
Faculty of Business Management, Universiti Teknologi MARA, Malaysia.
zafaran@salam.uitm.edu.my

ABSTRACT

Supply chain performance and effective management of supply chain have been increasingly recognized as critical factors in gaining competitive advantage. More and more firms are increasingly making use of SCM to improve their performance. This paper presents the findings of a research which examines the relationship between supply chain management (SCM) practices and process performance in manufacturing companies in Malaysia. The study measures senior management's perception of SCM practices and the level of process performance in the industry. Associations between SCM and process performance are analyzed through methods such as Pearson's correlations, cluster analysis and Structural Equation Modeling (SEM) using 250 respondents' data. The findings suggest that SCM practices have significant correlations with process performance (comprises of processes such as demand management process, customer relationship management process, customer service management process and order fulfillment process). Specifically, process performance has high correlations with SCM practices namely as 'strategic supplier partnership', 'customer relationship performance', 'information sharing', 'lean production' and 'postponement concept' and 'technology and innovation'. The SEM result also reveals that SCM practices exhibit direct impact on process performance. Findings of the study provide a demonstration of the importance of SCM practices in enhancing process performance in Malaysian manufacturing companies.

Keywords: Supply chain management, SCM practices, process performance, business performance, manufacturing companies, changes, Pearson's correlation, cluster analysis and structural equation modeling.

INTRODUCTION

Today's global marketplace offers tremendous opportunities in achieving strategic competitiveness through effective supply chain management (SCM). The environment in which firms operate, today, has changed drastically with the growth in collaboration between competitors as well as business partners, outsourcing and also integrated supply chain systems. As global competition increases, businesses should be more involved in how their suppliers and customers do business. To compete successfully in today challenging business environment manufacturing companies should be able to effectively integrating the internal functions within a company and effectively linking them with the external operations of suppliers and supply chain members. They need to focus on supply chain management practices that have impact on enhancing SCM activities such as where materials come from, how their suppliers' products are designed and assembled, how products are transported and stored and what consumers really

wants. The process of making and distributing products and services to customers is becoming the most effective and efficient way for businesses to stay successful and is central to the practice of supply chain management.

Empirically, the purpose of this study is to present an explicit result on the relationship between SCM and process performance where other researchers have perhaps known or describe them only implicitly. There are studies which suggest that SCM improves performance but, with a few exceptions, rarely support it with statistical evidence. This study is one of few attempts to estimate the effect of implementing SCM programs on process performance. It fills a gap that exists in the literature on SCM in the manufacturing industry in Malaysia.

Since the purpose of this paper is to enhance managerial understanding of supply chain management and process performance in relation to SCM implementations, the main objectives of this paper are:

(1) To empirically investigate relationship between supply chain management (SCM) practices and process performance.
(2) To empirically assess the structural effect of each SCM practice.

This paper explores the possibility of adopting SCM as the basis for enhancing process performance in manufacturing companies. First, this paper proceeds with an introduction, the objectives of the study and the test conducted to obtain the reliable measures of the variables; Secondly, it continue with a brief explanation on the SCM principles and literature review; Thirdly, it describes the conceptual framework consisting of the conceptual model and hypotheses; Fourthly, it discusses the methodology adopted; Fifth, it highlights the results of Pearson correlations, cluster analysis and structural equation modeling. Finally, the results are then discussed and implications highlighted.

SUPPLY CHAIN MANAGEMENT (LITERATURE REVIEW)

Supply chain management includes managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer. The term SCM was first used in the 1980s and as such is a relatively new discipline within management theory with tools and concepts still being developed. As with most management subject areas, many definitions have been used to explain the term SCM. The frequency with which the term “supply chain management” (SCM) is used in today’s environment would suggest that it is a well understood concept accompanied by an accepted set of managerial practices. However, definitions of and approaches to SCM vary substantially from organisation to organisation. Schonsleben (2004) defines SCM as coordination of strategic and long-term cooperation in logistics networks (Windischer and Grote, 2003). Tan, et. al. (1998) defines SCM as the simultaneous integration of customer requirements, internal requirements and upstream supplier performance. Quinn (1997) similarly views the supply chain as a set of processes. According to Quinn (1997), the supply chain includes all of those activities associated with moving goods from the raw-materials stage through to the end user. This includes sourcing and procurement,

production scheduling, order processing, inventory management, transportation, warehousing and customer service. It also embodies the information systems which are necessary to monitor all of those activities. Ellram and Cooper (1990) viewed SCM as an integrating philosophy to manage the total flow of a distribution channel from supplier to the ultimate customer. Christopher (1998) defines the supply chain as the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer. Supporters of this approach (e.g. Hakansson, 1982; Wijnstra, 1998) argue that buyer-seller relationships are influenced not only by the characteristics of the product and the organizations involved, but also by the relationships between these organisations and other organisations which are part of the supplier network. SCM coordinates and integrates all of the supply chain activities into a seamless process. SCM links all of the partners in the chain, including departments within an organisation and external companies and information systems providers. A key point in SCM is that the entire process must be viewed as one system (Lummus and Vokurka, 1999). This definition highlights the importance of managing boundaries between business partners. Robinson and Kalakota (2000) view the supply chain quite simply as a "process umbrella" under which products are developed and delivered to customers. From a structural viewpoint, they argue, the supply chain refers to the complex network of relationships that organizations maintain with trading partners to source, manufacture and deliver products. According to this view, an ideal supply chain consists of multiple companies that function as efficiently and effectively as a single company with full information visibility and accountability. The supply chain can be conceptualised in a number of different ways, ranging from network studies through production chains to behavioural analysis of dynamic inter-firm relationships (Hart and Saunders, 1997). Research shows that the development of effective supply chain coordination involves a multidimensional approach to systems integration, encompassing logistical flows, transfer of learning and trust-based relationships (Oliver et al., 1996; Hart and Saunders, 1997).

According to Ganeshan and Harrison (1999), a supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply Chain Management (SCM) is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 1998).SCM involves integration, co-ordination and collaboration across organizations and throughout the supply chain. SCM comprises determinants such as strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. All these determinants are considered as building blocks of SCM in today's business environment. SCM involves integration, coordination and collaboration across organisations and throughout the supply chain. Supply chain management requires coordination with customers and suppliers. Firms must achieve a relatively high degree of integration before implementing SCM. Supply chain management has the potential to assist the organisation in achieving both cost and a value advantage (Christopher, 1998). To gain competitive advantage, organisations have to adopt supply chain management (SCM) approach and consider the supply chain as a whole. Many researchers claim that supply chain management can result in better supply chain performance (Christopher, 1998 and Christiansee & Kumar, 2000). But very few

empirical studies have been carried to investigate the relationship between SCM and performance.

INDEPENDENT AND DEPENDENT CONSTRUCTS' MEASUREMENT: VALIDITY AND RELIABILITY

In this study, validity and reliability tests were used to select and assess the final items of the independent constructs that would be used for statistical testing. The SCM variables in this study were adopted from prominent studies or sources (Gunasekaran et al, 2003, Kuei et al., 2001, Li et. al, 2002, Hill, 2003, and Vickery, 1999). In this study, SCM was operationalized based upon six different kinds of activities that manufacturers commonly used to integrate their operations with suppliers and customers namely strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. As the initial data analysis, the six SCM variables were subjected to validity and reliability tests before a single score can be calculated to represent each construct. Multi item scales were developed for each construct in the study. Before creating the final scales, the data were checked for normality and outliers.

Table 1: Factor Analysis and Reliability Test

CONSTRUCT	Exploratory Factor Analysis –EFA (Varimax Rotation)			Confirmatory Factor Analysis – CFA		Reliability Test
	Eigenvalue	% of Variance Explained	Cummulative Variance Explained	GFI	CFI	Cronbach's Alpha
SCM	6.192	44.229	44.229	0.978	0.988	0.887
Process performance	4.203	30.022	74.251	0.918	0.971	0.965

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization (KMO= 0.957)

Exploratory factor analysis, confirmatory factor analysis and Cronbach's reliability analysis were used to select and assess the final items that would be used for hypothesis testing. The critical variables of SCM in this study had content validity because an extensive review of the literature was conducted in selecting the measurement items. The SCM determinants in this study were adopted from prominent studies or sources (Zairi, 1998; Murray, 1997; Mabert, 1992; Richman & Zachary, 1993). As the initial data analysis, the six determinants of SCM were subjected to validity and reliability tests. Exploratory factor analysis was conducted to investigate whether the constructs as described in the literature fits the factors derived from the factor analysis. The result from the factor analysis indicates that the KMO (Kaiser-Meyer-Olkin) measure is 0.957 with significant chi-square value (Barlett's Test of Sphericity = 3192, probability value = 0.000).

The value of KMO in this analysis surpasses the threshold value of 0.50 as recommended by Hair et. al (1998) and all the eigenvalues of the two constructs are above 1.00. All variables or determinants exhibit high factor loadings and almost fall into the designated factors as described by the literature. This result provides evidence to support the theoretical conceptualization of each construct. In addition, confirmatory factor analysis (CFA) or a measurement model using AMOS 5 was employed for examining construct validity of each scale by assessing how well the individual item measured the scale (Ahire et al., 1996). The goodness of fit indices (GFI) and comparative fit index (CFI) of the exogenous determinants exceeded the 0.90 criterion suggested by Hair et al. (1998), hence, establishing the construct validity (see Table 2).

Since data for this study was generated using scaled responses, it was deemed necessary to test for reliability. The reliability analysis was conducted by calculating the Cronbach's alpha for the main constructs. The result shows that the Cronbach's alpha measures for the main constructs exceeds the threshold point of 0.70 suggested by Nunnally (1978). Alpha coefficients for SCM and performance scales ranged between 0.887 and 0.965 after the alpha maximization processes were carried out (Table 1).

CONCEPTUAL FRAMEWORK

This paper explores the relationship between supply chain management and process performance within the context of the Malaysian manufacturing industry. The proposed model, as depicted in Figure 1, is based on two main constructs namely: (i) Supply Chain Management (SCM); and (ii) process performance (PROCESS).

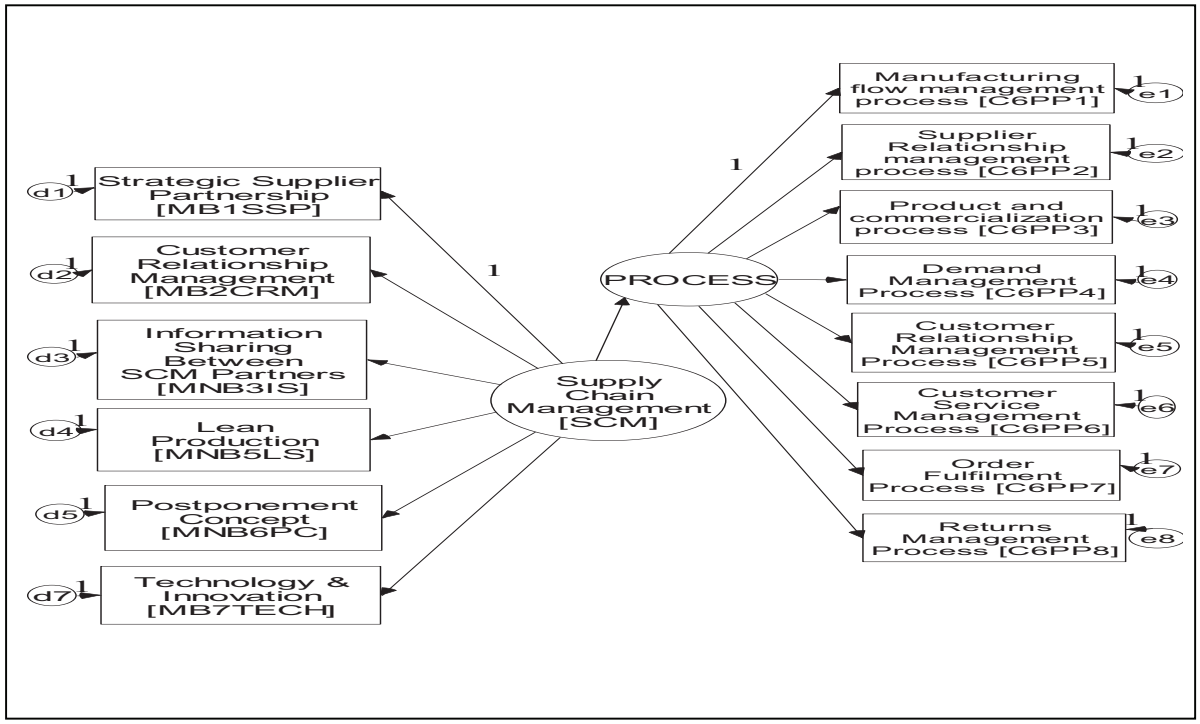

Figure 1: The conceptual model linking SCM and process performance

In this study, SCM represents a manager's assessment of the overall level of supply chain management practices (Davis & Heineke 2005, Mekong capital.com, 2004). In addition to improving levels of performance, SCM has also been shown to provide benefits in terms of outcomes (Inman, 1999, Arnheiter, & Maleyeff, 2005). The model proposed here uses SCM dimensions derived from studies and documented references. Six dimensions of SCM identified from several sources (Davis & Heineke 2005, Mekong capital.com, 2004) were considered to relate to distinctive features of SCM and are therefore incorporated in the present conceptual model. These SCM dimensions are strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation

In addition, several studies have identified performance improvement constructs that are commonly associated with SCM (Voss, 1988, *Gunasekaran et al, 2003, Kuei et al., 2001 and Cox, 1999*). Voss (1988) classified performance measures into three groups: market place competitive advantage, productivity increases, and non-productivity benefits. Specifically, this study focus on the impact of SCM on process performance which comprises dimensions namely manufacturing flow management process, supplier relationship management process, product and commercialization process, demand management process, customer relationship process, customer service management process, order fulfillment process and returns management process. Items included in the instrumentation for process performance, include such aspects relating to value chain cost, on-time delivery as well as inventory turnover.

Hypotheses

In investigating the influence of SCM practices on process performance, structural equation modeling is utilized to evaluate and analyze the magnitude and direction of the linkages between those constructs. The main hypothesis proposes that SCM has a positive structural effect on process performance. Conceptually, it suggests that with good implementation of SCM, process performance would be enhanced. Hence, in short, this study tests the following main hypotheses:

H_1: SCM has a positive structural effect on process performance (PROCESS).

In investigating the structural effect of SCM on overall results such as process performance, it is also pertinent to determine the structural loadings of each SCM determinant. Therefore, this study also attempts to test the following additional hypotheses:

H_{1A}: Strategic supplier partnership has a positive structural loading on SCM.
H_{1B} Customer relationship management has positive structural loading on SCM.
H_{1C}: Information sharing between SCM partners has a positive structural loading on SCM.
H_{1D}: Lean production has a positive structural loading on SCM.
H_{1E}: Postponement concept has a positive structural loading on SCM.
H_{1F}: Technology & innovation has a positive structural loading on SCM.

More importantly, this study aims to test the overall SEM model fit based on the main null hypothesis:

H_0 : The overall hypothesized model has a good fit.

For structural modeling, accepting this hypothesis indicates that the model presented adequately reproduce the observed covariance matrix (Bollen, 1989; Joreskog, 1989; Mueller, 1996) and suggesting that the data fit the proposed model.

RESEARCH METHODOLOGY

Sample companies were chosen from the manufacturing industry in Malaysia (the sampling frame was derived from the Federation of Malaysian Manufacturers Directory-FMM). Two hundred and fifty responses were received from a total of 300 sample companies chosen which representing 83 percent response rate. The primary purpose of the research is to gain insight into the benefits of implementing SCM in the manufacturing industry. The goal is to understand and determine measures of SCM that can enhance process performance. Face to face interviews with production or SCM managers were carried out to ensure the information accuracy, validating the outcome of analysis and developing an understanding of practical aspects of SCM principles adoption. To enable respondents to indicate their answers, seven–point interval scales were use for the questionnaire. Several items of SCM, which have been widely referred, were extracted. Similarly, the dependent variable namely process performance also used a seven-point interval scale, representing a range of agreement on statement whether over the past three years these process performance measures are high relative to competitors after implementing SCM practices.

FINDINGS

Correlation Analyses

As a preliminary analysis, Pearson's correlation analysis was conducted to establish associations between SCM practices and process performance. Table 2 exhibits correlation among the SCM variables and process performance measure. On the other hand, Table 3 highlights the descriptive and multicollinearity statistics. The result indicates that the SCM practices have significant correlations with one another and also with process management. In addition, it suggests that those SCM practices complement each other and need to be implemented in a holistic manner. Furthermore, the collinearity test does not indicate any multicollinerity problem. Process performance has high correlations with SCM practices especially with strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation. These findings are consistent with several previous studies that proclaimed better organizational transformations as a result of SCM initiatives (*Womack et al., 1990; Womack and Jones, 1996, Lee, Peccei 2008, p4,* Inman, 1999, Arnheiter, & Maleyeff, 2005).

Table 2: Pearson's correlation among variables

SCM variables		1	2	3	4	5	Mean Process Performance
1	Strategic supplier partnership	1.00					.583(**)
2	Customer relationship management	.629(**)	1.00				.526(**)
3	Information sharing between SCM partners	.632(**)	.509(**)	1.00			.482(**)
4	Lean production	.619(**)	.573(**)	.548(**)	1.00		.617(**)
5	Postponement concept	.533(**)	.570(**)	.555(**)	.608(**)	1.00	.588(**)
6	Technology & innovation	.637(**)	.552(**)	.573(**)	.608(**)	.598(**)	.643(**)
	1. *P≤0.05, **P≤0.01 2. All t-tests are two-tailed						

Table 3: Descriptive and collinearity statistics

SCM		Mean	Std Dev	Collinearity Statistics	
				Tolerance	VIF
1	Strategic supplier partnership	5.1835	.9755	.407	2.456
2	Customer relationship management	5.5372	.9582	.506	1.978
3	Information sharing between SCM partners	4.6710	1.3753	.511	1.955
4	Lean production	5.2135	1.0887	.467	2.140
5	Postponement concept	5.3147	.9791	.492	2.032
6	Technology & innovation	4.9412	1.2641	.461	2.169

Notes: *p ≤ 0.05; **p ≤ 0.01 (all *t*-tests are one-tailed)

Cluster Analysis and Friedman's Rank Test

Since process performance is a very importance outcome in this study, therefore the cluster classification performed in this study is based on process performance clustering. This cluster analysis categorized these manufacturing companies into two groups:

(1) "High" process performance achievers
(2) "Average" process performance achievers

Table 4 highlights further information about the cluster groups. From the result, we can also infer that the higher level of SCM implementations are more realized in "High" process performance achievers than "Low" process performance achievers. "High" process performance achievers" put high priorities on lean production followed by technology & innovation, customer relationship management and postponement concept and. Investigating the background of these clusters, the result also indicates that the first cluster ("High" process performance achievers) comprises of large-scaled companies with average employees of more than 1,200 people and average approximated sales turnover of more than RM 1.5 billion. Mean while, the second cluster ("Low" process performance achievers) comprises of smaller companies with average employees less than 600 and average approximated sales turnover less than RM 80 million.

Table 4: Rankings of SCM practices based on process performance using Friedman's Test

SCM	"High" process performance achievers (n=151, chi-square = 81.135, significant=0.000, overall cluster's mean = 5.469)				"Average" process performance achievers (n=99, chi-square = 80.218, significant=0.000, overall cluster's mean = 4.486)			
	Friedman's Test	Rank	Mean	Std Dev	Friedman's Test	Rank	Mean	Std Dev
Strategic supplier partnership	2.82	5	5.0993	1.30450	3.62	4	4.6104	.80699
Customer relationship management	3.81	3	5.6309	.88895	4.56	1	4.9787	.93011
Information sharing between SCM partners	2.82	6	5.0993	1.30450	2.53	6	4.0177	1.21966
Lean production	4.11	1	5.7479	.82535	3.67	3	4.5767	1.06008
Postponement Concept	3.38	4	5.5057	.99679	3.86	2	4.6539	.81407
Technology & innovation	4.05	2	5.7343	.64036	2.76	5	4.0801	1.13977

Structural Equation Modeling

(i) The result of the preliminary model (Model A).

The study postulates that SCM has influence on product quality performance. Given the confirmatory nature of this study, the statistical analysis technique called Structural Equation Modelling (SEM) was utilized. A SEM model was employed to investigate simultaneous linkages that allow a researcher to determine the relative strength of relationships between variables. A two-step approach was employed. First, confirmatory factor analysis was performed to ensure that all the indicator variables used to measure the constructs were reliable and valid. Second, causal relationships between constructs were postulated and tested. The SEM model was evaluated to check if the specified items provided adequate fit. The relationship of SCM practices on process performance is depicted in the preliminary model as shown in Figure 2. In this statistical analysis, we would like the model developed to fit the data, therefore the acceptance of the null hypothesis of the overall model is expected. Hence, in this test of goodness of fit for the structural equation modeling, the probability we are looking for should be higher than 0.05.

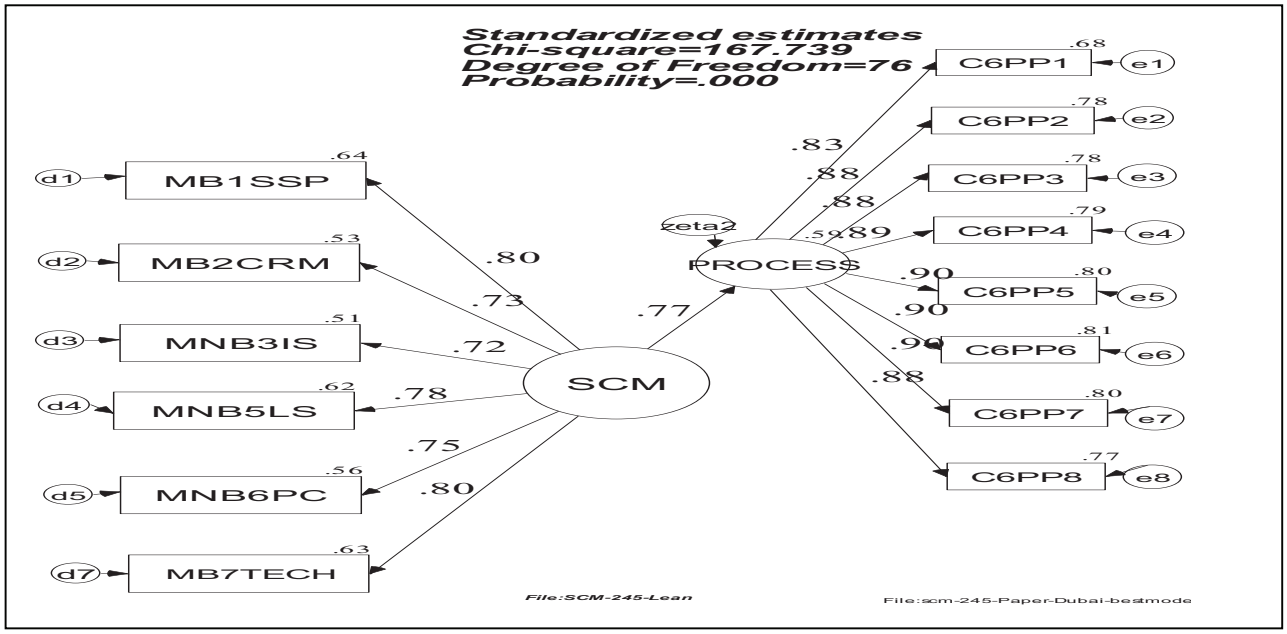

Figure 2: The result of the preliminary model (Model A) showing the structural linkage between SCM practices and process performance.

Unfortunately, the result of the preliminary model indicates that the χ^2 test and the probability value suggest a poor fit. The value of the Chi-square is equal to 167.74 with 76 degrees of freedom and the probability level of 0.000 (Table 5). On the whole, the result suggests that the proposed preliminary model has only a null fit and the data did not adequately fit the model. The unsatisfactory fit may relate to the high levels of random error and the many parameters that must be estimated (Bagozzi et. al 1991).

Table 5: The Measurement Result of the Preliminary Model

Statistics	Model Values	Recommended * values for good fit
Chi square	167.739	-
Probability Level	0.000	≥ 0.05
Degree of Freedom	76	-
χ^2 /df	2.209	≤ 3.00
Bollen (1989) Incremental Fit Index (IFI)	0.971	≥ 0.90
Tucker & Lewis (1973) TLI	0.965	≥ 0.90
Bentler (1988) comparative fit model (CFI)	0.971	≥ 0.90
Normed fit index (NFI)	0.949	≥ 0.90
Goodness of fit index (GFI)	0.912	≥ 0.90

*Chau (1997)

Even though the overall model has an unsatisfactory fit, the contributions of manifest variables in the model as well as the statistical significance of parameters' estimates of SCM and process performance are investigated. Standard errors and probability values are used to determine the precision of each parameter estimate. Parameters whose critical ratios are larger than 2.00 in magnitude are judged to be different from zero (Joreskog & Sorbom, 1989; Sharma, 1996, Mueller, 1996). The result indicates that the parameters have significant relationships and the variables are contributing to the concept. The loadings of the SCM variables (Figure 2) on the main latent construct suggest that strategic supplier partnership (0.798), technology and innovation (0.797), lean production (0.785) and postponement concept (0.750) are among the top variables with high contributions toward the SCM implementation. All SCM indicators exhibit significant critical ratios of above 2.00 (see Table 6). Therefore, we can suggest that strategic supplier partnership, customer relationship management, information sharing between SCM partners, lean production, postponement concept and technology & innovation have positive and significant impact on SCM implementations.

Table 6: The Measurement Result of the preliminary model

(i)Constructs and indicators	Std. Loadings	Std. errors	Critical Ratio	Probability
a. Supply Chain management (SCM)				
Strategic supplier partnership	.798	.068	13.450	0.000
Customer relationship management	.731	.073	12.293	0.000
Information sharing between SCM partners	.717	.106	12.010	0.000
Lean production	.785	.082	13.450	0.000
Postponement concept	.750	.074	12.691	0.000
Technology & innovation	.797	.094	13.705	0.000
b. Process performance (PROCESS)				
Manufacturing flow management process [C6PP1]	.827	.133	11.734	0.000
Supplier relationship management process [C6PP2]	.883	.053	19.112	0.000
Product and commercialization management process [C6PP3]	.882	.054	11.734	0.000
Demand management process [C6PP4]	.888	.060	18.101	0.000
Customer relationship management process [C6PP5]	.896	.060	18.366	0.000
Customer service management process [C6PP6]	.897	.062	18.429	0.00
Order fulfillment process [C6PP7]	.987	.062	18.418	0.000
Returns management process [C6PP8]	.878	.063	17.739	0.000
(ii) Exogenous/endogenous Path				
a. SCM→ PROCESS [H_1 is supported]	.767	.079	11.254	0.000

Specifically, in order to ensure the success of SCM implementation, manufacturing companies need the support and commitment from SCM partners, adopt new technology and innovation in production process and SCM activities, eliminating waste wherever possible through lean production and be flexible in meeting changes needs and demand from customers using postponement concept. Surprisingly, information sharing between supply chain partners is not among top indicators of SCM in manufacturing industry in Malaysia. Probably the logical reason is because the culture of sharing vital SCM informations is not yet widespread in manufacturing companies in Malaysia. In addition, since customer relationship management (CRM) is still a new concept, this could explain why CRM has lower structural loadings on SCM implementations. By examining the structural loadings and their respective critical ratios and probability values, we can conclude two things. Firstly, we can say that strategic supplier partnership, technology and innovation, lean production and postponement concept have higher structural contributions toward SCM in manufacturing companies in Malaysia. Secondly, the

significant critical values indicate that SCM has positive effect on process performance. However, the overall result does not support the overall model fit, which is not uncommon when a measurement model has many items.

(ii) The improvement of the null model (Model B: The Parsimonious Model)

Since the overall result of the preliminary model (Model A) does not allow us to conclude that the suggested preliminary model has a good fit, the study will try to look at the element of standard structural validity for the modification of the overall model to improve its fit and to determine which of the exogenous and endogenous variables that are responsive and have direct causal relations with their latent construct (Joreskog and Sorbom, 1989). In addition, according to Tamini (1998), if the constructs were related to each other, they would all load on a higher order factor loading. Hence in this study, the model will be respecified by examining the exogenous measurements (SCM indicators) and investigating their contributions toward the main latent construct (SCM) and simultaneously the manifest variables of the endogenous construct will also be reexamined. According to Joreskog and Sorbom (1989), a structural loading (λ_{ij}^{s}) is a measure of the extent to which the variation of one indicator explains the variation of the latent variable. The indicator with the highest factor loading is the most valid indicator of its latent variable. High factor loadings are thus good indicators of the convergent validity of constructs. Closer examination of the parameters of the preliminary model (Figure 3) showed that the structural loading of customer relationship management (CRM) and information sharing between supply chain are not as high as the other four SCM variables (strategic supplier partnership, technology and innovation, lean production and postponement concept). This could be an indication that these variables have lower contributions and less responsive toward SCM implementations in manufacturing companies in Malaysia. Even though these variables exhibit significantly positive contributions toward SCM, however, they do not respond to the simple and direct relationship between SCM and process performance. This could mean that these SCM variables may be related to process performance in a more complex manner. As for the endogenous variables, only demand management process, customer relationship management process, customer service management process and order fulfillment process have high loadings and impact on the main latent construct. To improve the result, a second analysis on the respecified model is later performed to achieve a feasible and parsimonious model (Model B) with a more satisfactory fit.

(iii) The result of the final model (The parsimonious model)

The final parsimonious SEM model (Figure 3) exhibits the structural relationship of SCM on process performance after the modification process has been carried out. Note that in this model, two SCM variables namely customer relationship management and information sharing are dropped. Inversely, for the endogenous variables, demand management process, Customer relationship management process, demand management process, customer relationship management process, customer service management process, customer service management process and order fulfillment process high structural loadings and more responsive towards the impact on process performance, and therefore are retained in the revised model. The findings of Model B (the revised and parsimonious model) indicate that the resulting Chi-square value is

28.925 with 19 degrees of freedom and p-value of 0.067 (Figure 3 and Table 7). This supports the null hypothesis that the revised model has a good fit (H_0). The p-value is considerably substantial (p-value > 0.05), in supporting the proposition that the overall model fits the data. In addition, other statistical structural indices such as Bentler CFI (0.994), Bollen IFI (0.994) and Tucker and Lewis TLI (0.990) further suggest that the model has a satisfactory fit (Table 7). Since the probability value and structural modeling indices are well above the recommended level, the model is considered to be a reasonable representation of the data (Hair et al., 1995).

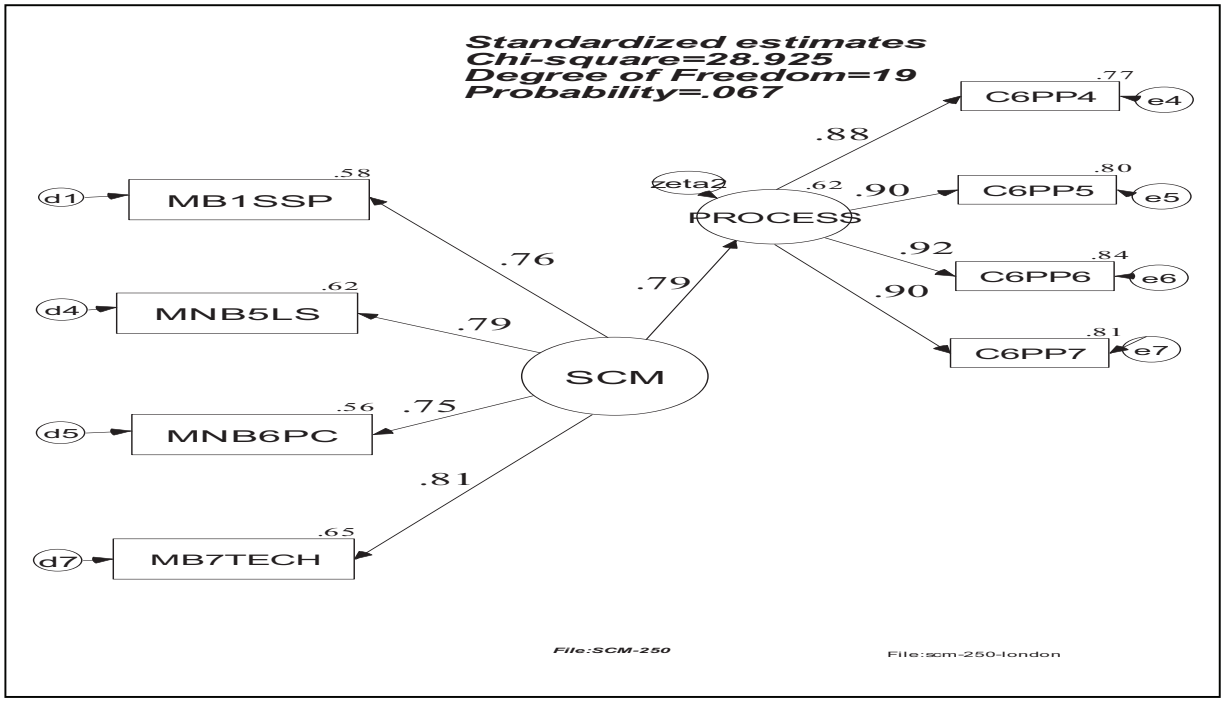

Figure 3: The final parsimonious SEM model showing the structural linkage between SCM practices and process performance (Model B).

Table 7: Measurement Results of the final SEM Model

Statistics	Model Values	Recommended * values for good fit
Chi square	28.925	-
Probability Level	0.067	≥ 0.05
Degree of Freedom	19	-
χ^2 /df	1.522	≤ 3.00
Bollen (1989) Incremental Fit Index (IFI)	0.994	≥ 0.90
Tucker & Lewis (1973) TLI	0.990	≥ 0.90
Bentler (1988) comparative fit model (CFI)	0.994	≥ 0.90
Normed fit index (NFI)	0.981	≥ 0.90
Goodness of fit index (GFI)	0.972	≥ 0.90

*Chau (1997)

The direct structural effect of SCM on process performance (PROCESS) is high (0.79) given the complex causal linkages, suggesting the significant importance of SCM practices especially strategic supplier partnership, technology and innovation, lean production and postponement concept in manufacturing industry in Malaysia (H_{1A}, $H_{1D,}$ H_{1E}, and H_{1F} are supported).. The standardized structural coefficient of SCM on process performance (0.79) is associated with low standard error (0.093) and non-zero critical value (11.295), which indicates that the structural effect between these two constructs, is positive and the relationship is significant (Table 8). Therefore, we have enough evidence to accept the proposition that SCM has a positive structural effect on process performance (H_1 is supported). In addition, we can obviously suggest that SCM practices can help manufacturing companies improve demand management process, customer relationship management process, customer service management process and order fulfillment process.

Table 8: Measurement results of the final SEM model

(i)Constructs and indicators	Std. Loadings	Std. errors	Critical Ratio	Probability
a. SCM (SCM)				
Strategic supplier partnership	.760	.070	12.334	0.000
Lean production	.788	.094	12.333	0.000
Postponement concept	.747	.085	11.655	0.000
Technology & innovation	.805	.109	12.613	0.000
b. Process performance (PROCESS)				
Demand management process [C6PP4]	.876	.048	20.376	0.000
Customer relationship management process [C6PP5]	.896	.041	22.772	0.000
Customer service management process [C6PP6]	.747	.047	22.771	0.000
Order fulfillment process [C6PP7]	.901	.048	21.786	0.000
(ii) Exogenous/endogenous Path				
a. SCM→ PROCESS [H_1 is supported]	.786	.093	11.295	0.000

Looking at the loadings of the SCM variables (Table 8) on the main construct, we can see that technology and innovation has the highest contribution towards SCM and it is followed by lean production, strategic supplier partnership and postponement concept. All of these indicators have significant probability values (critical values ≥ 2.00), giving statistical evidence that their contributions towards SCM construct are significant and positive. Therefore a manufacturing company can enhance its by integrating and implementing SCM strategies and practices.

CONCLUSION AND IMPLICATIONS

Many manufacturing companies have fought the global pressures of competition by becoming increasingly technologically advanced, moving up-market to more value-added products, and upgrading the skills of their domestic work force. SCM provides a vision that focuses everyone in an organization on better improvement. The pursuit of improvement is not only requested by the market but also driven by the need to survive. This paper tries to investigate the structural relationships between SCM and process performance in manufacturing companies in Malaysia. On the whole, we can suggest that SCM has a positive impact on process performance. Initially, the result of the preliminary model indicates that relationship between SCM and process performance only suggests a null fit. Viewing the result of the preliminary model on the relationship between SCM and process performance, the findings suggest a conclusion that there is no firm and direct link between some of the SCM variables and some of the process performance indicators. It should be noted that the model presented in this study reflects linear and direct linkages between SCM and process performance. It could well be that some of the variables of SCM and the indicators of process performance are related in a more complex way. Given that the results of this study show no empirical support for simple structural linkages, it is suggested that these constructs may be related in a more complex manner. However, further investigation on the contributions of each of the SCM variables and process performance indicators signals that some of the indicators are more responsive to the causal relationship between SCM and process performance, which suggests possible direct linkage between them. A revised model was analyzed which retained some of the more responsive manifest variables. The result of the revised and parsimonious model indicates a satisfactory fit.

SCM practices provide a vision that focuses everyone in an organization on SCM improvement. The pursuit of better improvement is not only requested by the market but also driven by the need to survive. This paper tries to investigate the structural relationship between SCM and process performance in the Malaysian manufacturing industry. The associations and effects of the SCM variables were evaluated using correlations, Friedman test and SEM. The results of the study assist in understandings on how SCM practices influence process performance. This study leads to several main conclusions. First, evidences suggested that:

(1) Technology and innovation, lean production, strategic supplier partnership and postponement concept have **positive** and **direct** effects on process performance.
(2) SCM practices have **positive** and **significant direct** effects on process performance specifically demand management process, customer relationship management process, customer service management process and order fulfillment process.

The conclusion emerging from this study is that SCM will ultimately results in positive gains. The results validate some of the key linkages and support beliefs and evidence by researchers of the relationship between SCM and process performance. It is also important to note that this study attempts to enrich the literature review and make a contribution in SCM-related studies. Obviously, its purpose has been to make explicit what other researchers have perhaps known implicitly with solid measurements. The empirical results support long-standing beliefs and anecdotal evidence by researchers about the relationships between the exogenous (SCM) and endogenous results (process performance), and lend credibility to causal hypotheses that

improving internal process leads to improvements in external performance results. This study to some extent helps in resolving controversy about the magnitude and measurements of performance gains from implementing SCM. By strengthening SCM practices, improved performance will likely to occur. This result provides evidence that improving internal practices will positively impact the most important performance measures.

This paper is relevant to practitioners because the findings may reveal important aspects in the implementation of SCM practices, which may provide significant information managers can use to solve implementation challenges and perhaps to improve performance. The paper would be of particular interest to practicing production managers or SCM managers as it suggest what factors should be emphasized to stimulate the adoption of SCM concepts in the Malaysian manufacturing industry. Moreover, the findings may provide support for continued implementation of SCM practices. The result indicates that manufacturing companies should emphasize greater attention to the technology and innovation adoption, waste reduction aspects through lean production and strategic partnership of the SCM practices and a greater degree of management support for SCM programs. Finally, the conclusion emerging from this study is that SCM will ultimately results in positive gains. The results validate some of the key linkages and support beliefs and evidence by researchers of the relationships between SCM and process performance. It is also important to note that this study attempts to enrich the literature review and make a contribution in SCM-related studies. In addition, its purpose has been to make explicit what other researchers have perhaps known implicitly. However rather than being conclusive, this study opens new avenue for future research.

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AUTHOR'S BACKGROUND

Arawati Agus is a Professor of Quality and Operations Management at Graduate School of Business, National University of Malaysia (UKM). She received a Bachelor degree in Finance from Southern Illinois University and Master in Management Sciences from St. Louis University. She obtained her Ph. D. in National University of Malaysia (UKM). Her area of research includes Quality Management, Supply Chain Management, Operation Management, Service Quality and Entrepreneurship. Her works have been published in Total Quality Management (UK), International Journal of Management, Singapore Management Review, International Journal of Production Economic, Security Industry Review (Singapore), Journal of Quality and Reliability, Malaysian Management Review and Management Journal (UKM).

Za'faran Hassan is an Associate Professor at the Faculty of Business and Management, Universiti Teknologi MARA. She obtained her BBA at Idaho State University, USA; MBA at Saint Louis University, Missouri, USA; and DBA at National University of Malaysia (UKM). She is an Associate Professor at Universiti Teknologi MARA, Malaysia. Her past administrative experience includes being the Dean of the Faculty of Hotel and Tourism Management, Director for Business Development, as well as Head of the Malaysian Entrepreneurship Development Center at her university. Currently, she is the Head of the Faculty of Business Management's Department of Management, Human Resource Management and International Business. She is an industry member for the Malaysian Productivity Corporation's Consultative Panel of Expertise for Tourism, Member of the Malaysian Institute of Management, and the Academy of International Business, as well as Associate Member of the Centre for Small Business & Regional Research (CSBRR), University of Wollonggong, NSW, Australia. She has presented papers at conferences and also published in various publications, both locally and internationallyShe is also a member of various local and international professional associations such as the Malaysian Institute of Management (MIM), Malaysian Society for Training and Development (MSTD), and the Academy of International Business (AIB). Her research interest includes areas related to Management, Strategic Management, SMEs, Entrepreneurship, Supply Chain Management and Quality Management.

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CUSTOMER SATISFACTION WITH INFORMATION TECHNOLOGY IMPLEMENTATION IN A GOVERNMENT AGENCY: A SURVEY ON ROYAL MALAYSIAN CUSTOMS

Najmi Mohd. Radzi, Royal Malaysian Customs, Malaysia
najmi@customs.gov.my
Dr. Abu Bakar Abdul Hamid, Universiti Teknologi Malaysia, Malaysia
m-abakar@utm.my
Dr. Chong Siong Choy, Putra International College, Malaysia
scchong@iputra.edu.my

ABSTRACT

This study is conducted to investigate the extent of customer satisfaction of the service delivery process through the implementation of information technology (IT) in the Royal Malaysian Customs (RMC), one of the prominent and technology-pioneering government agencies in Malaysia. Data were collected from two types of customers, i.e. internal (employees) and external (business clients), specifically from the RMC officers in the state of Selangor who use the Customs Information System (CIS) for the transhipment of goods (Customs Form 8-C8) and its business clients who comprise of forwarding agents, importers, and bonded warehouse licensees in the same state. The findings reveal that both types of customers are either indecisive and/or doubtful with the performance of CIS used by the RMC. It can be concluded that it is of paramount importance for the RMC, a government agency that provides service to the industrial population as its core business, to fulfil the satisfaction of both types of customers by provision of improving its service delivery process through the CIS used so as to ensure that the adoption of IT produces desirable outcomes.

Keywords: Information technology implementation, e-government, customer satisfaction, business clients, Royal Malaysian Customs, Malaysia

INTRODUCTION

Malaysia aspires to be a developed country comprising of a community that has an abundance of information and knowledge by the year 2020 in line with the National Vision Policy. With the awareness on the importance of technological knowledge as a catalyst for the development of the nation, the Malaysian government has conceptualized the Multimedia Super Corridor Malaysia (MSC Malaysia) project (for details, see Mohd Fairuz et al., 2008). In addition, the development of Putrajaya (the nation's administrative center within the MSC Malaysia) with state-of-the-art and sophisticated information and communications technology (ICT) and information technology (IT) infrastructure has completed the circle of IT development in Malaysia (Hizral, 1999).

Further, the government has provided a substantial sum of money for the delivery of electronic public services, more popularly known as Electronic Government (E-Government). E-government is referred to as the implementation of ICT to transform the structures and processes of government organizations aiming at performance improvement (Mofleh et al., 2009). It enables the simplification and automation of transactions between citizens and businesses, and even with different government entities (Metaxiotis and Psarras, 2005;

Sprecher, 2000) through multiple channels by using ICT, whose objective is to improve the efficiency, transparency, accountability, and effectiveness of the government (Gil-Garcia and Pardo, 2005; Gorla, 2008). By using ICT, the role of government changes from direct to a more limited involvement, thereby empowering citizens (Yu and Fang, 2005). As a facilitator of good governance (Rose, 2004; Sharma, 2004; Zhang, 2004), e-government thus has the ability to improve democratic, economic, and administrative governance (Gorla, 2008).

Gorla (2008) opines that e-government is becoming increasingly important due to the growth of ICT and Internet penetration. In Malaysia, for instance, the Malaysian Communications and Multimedia Commission reported that the penetration of Internet in 2007 is about half the size of the population (47.8% of 28,294,120 people) as opposed to 3,700,000 users in 2000 (http://www.mcmc.gov.my). This is due to the many initiatives undertaken by the Malaysian government in the development of ICT infrastructure and environment so as to enable the country to move rapidly into the Information Age as part of an important agenda of transforming the country into an information and knowledge-based society by 2020 (Tan et al., in press). Another reason is being the encouragement given to the development of ICT in the country as evident from the Seventh Malaysia Plan (1996-2000). This was the period that saw the inception of the MSC Malaysia (Chong, 2006). In fact investment of ICT in Malaysia has expanded at a rate of 9.2% per annum from RM3.8 billion in 1995 to RM5.9 billion in 2000 (Economic Planning Unit, 2001). About RM7.9 billion was invested on ICT programs under the Eighth Malaysia Plan (2001-2005) such as computerization of government agencies, schools, ICT funding, multimedia applications and developments, as well as ICT research and development. The following Ninth Malaysia Plan (2006-2010) witnesses an allocation of RM12.9 billion for the same programs (Economic Planning Unit, 2006).

Under the e-government initiative, a number of flagship projects have been developed and successfully implemented involving many areas such as smart school, telemedicine and the national smart identity card which involved a budget of RM1.06 billion. Several systems have also been created such as the Smart Transportation System which helps to eliminate traffic congestion in the Klang Valley area on top of imparting important information to traffic users. Other systems include the Project Validation Process, Human Resource Management System, E-Procurement, and the Generic Office Environment. Another measure that had taken place in is the launch of a program 'My-EG', in which a selection of public services is being made available online. From such developments, coupled with the development of broadband wireless Internet access, it can be seen that the Malaysian government is gearing up for change by putting into action a blueprint for the assimilation of IT into its governance structure.

It is therefore not surprising that the Royal Malaysian Customs (RMC), a government agency responsible for the collection of indirect tax and at the same time providing facilities to the commercial and industrial sectors, together with the task of safeguarding the national economy, social and security, is jumping on the IT bandwagon in its effort to prepare the agency towards the realization of Vision 2020. As a matter of fact, the RMC is among the first government agencies that adopted electronic data interchange (EDI) in 1994 as modified from the United Nations/Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT). As part of the e-government initiatives, the RMC introduced the Customs Information System (CIS) through the custom declaration forms in 1992 with manual key-in process designated for four types of forms, i.e. C1 (import), C2 (export), C8 (transshipment), and C9 (import-break bulk). In 1994, the RMC began using the EDI in

addition to CIS for its C1 and C2 forms. In 1997, the EDI and CIS were further augmented with the introduction of a single Electronic Fund Transfer (EFT) system, which was later upgraded to multiple EFT in 2003 which saw the application of EDI and CIS for C8 and C9. In January 2003, the use of EDI and CIS was enforced on the Paperless Export Normal C2 (for non-dutiable goods) form, which was extended to dutiable goods in July of the same year. In January 2004, the RMC introduced the Inter-station Centralization System (C8).

Notwithstanding its popularity, the applicability and practicability of e-government has been extensively debated (Ciborra, 2005; Davison et al., 2005; Holliday, 2002). Davison et al. (2005) for instance opine that it is reasonable to query whether governments really want to make the transition to e-government. This is attributed to the fact that the success of IT adoption in the public sector has not been very clear and/or consistent due to lack of research (Tang et al., 2009). Further, many e-government studies have focused on developed countries (Ke and Wee, 2004; Kolsaker, 2006; Lee et al., 2005) with very few research attempts being undertaken on developing countries. In addition, e-government is an evolving, multidisciplinary topic that involves various stakeholders with multiple value dimensions (i.e. financial, social, and political) (Chirchu, 2008; Yang and Paul, 2005). This led to the lack of clear understanding of managerial practices surrounding the role of central governments in the deployment and development of e-government (Mofleh et al., 2009). On the contrary, IT has been adapted by many multinational corporations (MNCs) and businesses with the key objective to tailor the available and emerging technologies to the specific requirements of those firms in order to increase efficiency and effectiveness of their delivery systems which ultimately help to realize their organizational goals. Matching both the elements is however a difficult task in the public sector which face different sets of priorities and therefore challenges compared to the business sector (Chirchu and Lee, 2005; Davison et al., 2005; Gil-Garcia and Pardo, 2005). This is evident from a study by Ghapanchi et al. (2008) who identified as many as 12 e-government implementation challenges. While the opponents failed to dissuade governments in the use of ICT, they have conveyed a clear message that governments will never be prepared for the change that is taking place if they are unable to link the role of governments as public service providers and the function of IT that is to assist the delivery of service to the citizens.

As such, as a government agency that provides service to the industrial population as its core business and consequently one of the major government revenue generating agencies, it is crucial for the RMC to continuously assess and improve its service delivery system due to the involvement of many of its stakeholders, specifically between the agency, its officers, and the business entities it serves. The relationship between the agency and its business entities is deemed an important determinant of e-government success, as business rather than individual Internet usage has been found to have greater exploratory value as an antecedent to the availability of e-government services (Boyer-Wright and Kottermann, 2008). It is therefore imperative to identify the satisfaction levels of RMC's officers and its business customers toward the use of the CIS. The resulting feedback will serve to inform the service providers on the level of effectiveness of RMC's CIS process, i.e. whether the current IT implementation is adequate, or a reengineering process is required.

It is against this backdrop that this study investigates the impact of RMC's IT implementation on the satisfaction of its officers and business customers. Specifically, feedback is gathered from the RMC officers who are responsible for the approval of dutiable goods movement within the bonded warehouse department and the declarations made by forwarding agents,

importers, and bonded warehouse licensees through the process of declaration and approval of Customs Form No. 8 (C8) using the CIS. Procedurally, the RMC's clearance for C8 is very important to ensure that its business customers receive their goods on time without any delay as this can affect their businesses. As such, it is important to observe the satisfaction of these external customers. In addition, the RMC management must ensure that every stage in the IT adoption has been properly undertaken so that the system will work smoothly. This can be observed from the satisfaction of its internal customers (officers). The implementation of CIS C8 is very important for many reasons, central to the assumption is that with IT implementation, it will facilitate the RMC in providing better services to its business customers. In short, the study is undertaken to provide answers to the following research questions:

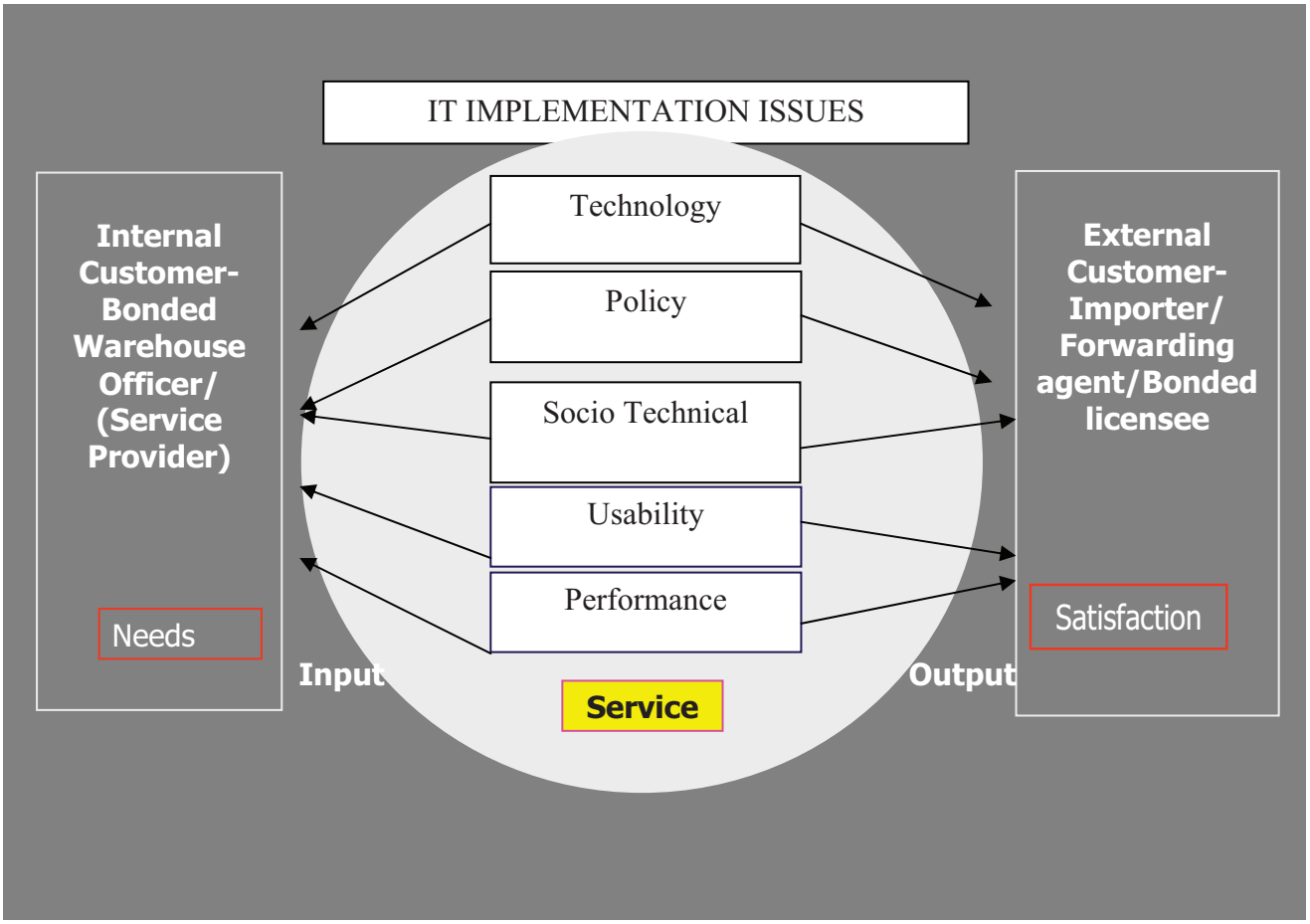
1) What is the level of IT utilization in terms of the CIS C8 declaration and approval process by the internal and external customers within the bonded warehouse department?;
2) What is the level of user satisfaction with regards to the CIS C8 process?; and
3) What are the areas that the bonded warehouse department should focus on to make sure that its IT implementation, specifically the CIS C8 process, is successful?

The rest of the paper is organized as follows. The next section presents the research framework employed in this study. The methodology used is detailed next, followed by presentation of the empirical results. The results are then discussed and implications provided before the paper is concluded.

RESEARCH FRAMEWORK

As Diagram 1 suggests, the RMC bonded warehouse officers provide service to their business customers in terms of granting approval to the transshipment of goods after their customers made declaration on the C8 form through the CIS. In providing the service through the use of CIS, the level of service quality is dependent on a number of factors such as technology, policy, socio-technical, usability, and performance on the part of the RMC as supported by the top management of the agency. At the same time, the same factors are also assumed to be important in fulfilling the needs and satisfaction of the business customers. On top of that, IT support infrastructure is also posited to contribute to the effectiveness of the service delivery. As such, the expected outcome is deemed to be the service realization through the use of the CIS process which will result in satisfaction to both the internal and external customers.

Diagram 1: Research Framework



RESEARCH METHODOLOGY

The research design is quantitative in nature, focusing on soliciting inputs and perceptions of the RMC bonded warehouse officers who are involved, and/or expected to be involved in any effort that will increase the performance and/or capabilities of their business customers, specifically on the C8 approval process through the use of CIS. These personnel comprise of all the RMC bonded warehouse officers from the lowest ranking to the most senior officers in the state of Selangor. This study focuses only on the state due to the fact that Selangor reported the highest revenue collection among all the states in Malaysia, with RM368.5 million collected in 2006 (representing 36% of all the revenues collected), out of which RM8.9 million is contributed by the bonded warehouse department. In terms of the total number of C8 clearance forms processed, the RMC's Annual Report (2005) indicates that Selangor ranked second after the state of Penang with 133,877 forms processed in 2005. Due to the small number of population, getting the involvement of as many RMC bonded warehouse officers as possible in the state is vital. There are currently 10 senior officers and 36 officers working in the department. About 34 officers agreed to take part in the survey.

The external customer is defined as those who are at the receiving end of the service which consists of managers and officers who manned the operations, purchasing, warehouse planning, and marketing departments of the forwarding agents, importers, and bonded warehouse licensees. As of 2007, there are approximately 1250 registered forwarding agents and 95 bonded warehouses in the state of Selangor. In practice, it is not uncommon to find that bonded warehouses seldom change forwarding agents. Moreover, it is not unusual for some established agents to handle a few bonded warehouses at the same time. This feature allowed the research to focus on respondents who are regular and familiar with the C8 declaration process using the CIS. About 35 business clients from 6 bonded warehouses took part in the survey.

Two sets of self-reporting questionnaires were developed and disseminated to both sets of the population. The questionnaires consist of two major sections. Section 1 is meant to solicit the respondents' demographic and psychographic information. Among the questions asked include age, highest education level, the availability of Internet connection, experience with Internet usage, and familiarity with the C8 process and CIS. Section 2 comprises of a series of items gauging the respondents' satisfaction levels on the various CIS implementation issues. About 51 items divided into 7 variables are administered to the RMC officers (refer Table 2), while the forwarding agents, importers, and bonded warehouse licensees were asked 31 questions from 5 variables (refer Table 3). All the questions in this section utilize a 5-point Likert scale, ranging from 1=highly dissatisfied to 5=highly satisfied with 3 scaled as neutral. Descriptive statistics, namely mean and standard deviation scores are used to interpret the data. Table 1 shows the interpretation of the mean scores obtained.

Table 1: Interpretation of the Mean Scores

Mean	Interpretation
1.00 – 1.49	Customer do not have anything that he/she is satisfied with
1.50 – 2.49	Customers' satisfaction at the lowest level
2.50 – 3.49	Indecisive , doubtful (customer doesn't give full attention)
3.50 – 4.49	Customers' satisfaction at a very high level
4.50 – 5.00	Customers' satisfaction exceeding beyond expectation

RESULTS

Demographic Profile of the RMC Officers

All the RMC officers are above the age of 26, with a majority of them possess minimum education qualifications (the Malaysian Certificate of Education or equivalent to GCE 'O' Levels). Many of the respondents have been in service for more than 15 years which explain the age and education level of the officers. About 41% of the officers own laptops, with 67% of them having Internet connectivity and 53% of them have experienced in using the Internet. However, it is interesting to note that the majority of respondents reported that they do not have Internet connection at the office (65%), and they therefore cannot access to the RMC's CIS at their workplace. The majority of the officers are familiar with the C8 process (64.7%) and the CIS (56%).

Level of Perceived Satisfaction of RMC Officers

Table 2 shows the results of descriptive statistics with regards to the satisfaction level of the RMC officers on the various CIS implementation issues. On an overall, the present IT environment scores the highest mean (3.34), followed by the contribution of IT through the satisfaction level of the overall CIS (3.30), the effect of technology and systems on effectiveness (3.21), level of IT usage in organization (3.17), IT in relation to management (3.02), socio-technical (2.99) and IT facilities (2.98). Based on the interpretation provided in Table 1, the mean scores of between 2.98 and 3.34 imply that the officers are indecisive and/or doubtful with the various issues asked upon them.

Similarly, the mean scores for each of the individual items suggest that the responses are within the range of neutral, judging from the mean scores of between 2.62 and 3.59. Only two items, i.e. "IT exposes me to become more creative" and "easy to analyze data" scored above or equal to 3.50. Satisfaction with the browsing speed scored the lowest mean. The responses to these questions corroborate the rates of satisfaction and/or dissatisfaction shown by the officers. About 62% of the officers are satisfied or highly satisfied with the exposure of IT that makes them more creative, while 56% of them are satisfied with the ease of data analysis. About 44% of them are dissatisfied of the browsing speed while 35% of them remained neutral on this item. The standard deviation scores for most of them items are below 1, indicating consistency in the respondents' answers.

Table 2: Descriptive Statistics of Perceived Satisfaction among the Internal Customers

	Descriptive Statistics	No	Mean	Std. Deviation	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Missing	Total
					Percentage						
Present IT	Faster information	34	3.206	1.067	5.88	20.6	29.4	35.3	8.82		100
	Effective info delivery	34	3.382	0.888	2.94	11.8	35.3	44.1	5.88		100
	Easy to analyze data	34	3.500	0.707		8.82	35.3	52.9	2.94		100
	Friendly IT environment	34	3.147	0.892		29.4	29.4	38.2	2.94		100
	Easy to communicate among staff	34	3.471	0.825		14.7	29.4	50	5.88		100
IT Facilities	Computer at workplace	34	3.000	0.985	2.94	32.4	32.4	26.5	5.88		100
	Software at workplace	34	3.059	1.013	2.94	32.4	26.5	32.4	5.88		100
	Technical support at workplace	34	3.000	0.921		38.2	26.5	32.4	2.94		100
	IT system at workplace	34	2.912	1.083	8.82	32.4	20.6	35.3	2.94		100
	Version of software used	34	2.912	0.996	5.88	32.4	29.4	29.4	2.94		100
	Reliability of equipment and peripheral	34	2.971	1.058	8.82	26.5	26.5	35.3	2.94		100
IT in relation to organizational Mgmt	Importance of IT training from dep't perspective	33	3.030	1.185	11.8	20.6	26.5	29.4	8.82	2.95	100
	IT awareness among mgmt	34	3.059	1.043	8.82	17.6	38.2	29.4	5.88		100
	Organizational image towards IT	34	3.235	0.955	5.88	11.8	41.2	35.3	5.88		100
	Department has effective guidelines	34	3.088	0.900		32.4	29.4	35.3	2.94		100
	Department allocates resources equitable	34	2.706	0.970	11.8	29.4	35.3	23.5			100
IT in relation to social technical interface	Regular hands-on workshop	33	2.788	1.053	11.8	26.5	32.4	23.5	2.94	2.95	100
	Frequent upgrade of PC	34	2.824	1.058	11.8	29.4	23.5	35.3			100
	Sufficient data communication	34	3.000	0.953	8.82	17.6	38.2	35.3			100
	Appropriate computer resources	34	3.147	0.989	5.88	17.6	38.2	32.4	5.88		100
	Appropriate software	34	3.235	0.987	5.88	11.8	44.1	29.4	8.82		100
	Good documentation	34	3.206	0.978	8.82	5.88	47.1	32.4	5.88		100
	Sufficient training	34	2.824	0.999	11.8	23.5	35.3	29.4			100
	Sufficient consulting	34	2.765	0.955	11.8	23.5	41.2	23.5			100
	Sufficient supporting staff	33	2.970	0.918	5.88	20.6	44.1	23.5	2.94	2.95	100
	Effective supporting staff	34	3.176	0.834		20.6	47.1	26.5	5.88		100
usage in organization	Have high level of IT knowledge	34	3.088	0.621		14.7	61.8	23.5			100
	Expert acquiring information through IT	34	3.029	0.627		17.6	61.8	20.6			100

	Doesn't required assistance	34	2.794	0.729	2.94	29.4	52.9	14.7			100
	Doesn't take time while retrieving data	34	3.059	0.776		26.5	41.2	32.4			100
	Complete understanding of IT usage	34	3.176	0.797	2.94	11.8	52.9	29.4	2.94		100
	Satisfied in using existing IT	34	3.118	1.008	2.94	32.4	17.6	44.1	2.94		100
	Can finish job faster	34	3.412	1.104	2.94	20.6	26.5	32.4	17.6		100
	Lots of my work involve IT utilization	34	3.235	0.890	2.94	14.7	44.1	32.4	5.88		100
	Existing IT gives me satisfaction	34	3.176	0.999	2.94	26.5	26.5	38.2	5.88		100
	IT exposes me to become more creative	34	3.588	0.821		11.8	26.5	52.9	8.82		100
Technology and Systems that affect the effectiveness	Screen layout design is appropriate	34	3.324	0.806		14.7	44.1	35.3	5.88		100
	Config of color & background clear/harmonious	34	3.382	0.739		11.8	41.2	44.1	2.94		100
	Screen guidance is clear and easy	33	3.333	0.736		11.8	44.1	38.2	2.94	2.95	100
	Easy access to information	34	3.471	0.896	2.94	8.82	35.3	44.1	8.82		100
	Information credibility	34	3.500	0.788		11.8	32.4	50	5.88		100
	IT infrastructure is reliable and safe	34	3.353	0.812		17.6	32.4	47.1	2.94		100
	No problem during navigating	34	3.059	0.886	2.94	23.5	41.2	29.4	2.94		100
	Rarely get disconnected	34	2.882	0.977	8.82	23.5	41.2	23.5	2.94		100
	Satisfactory browsing speed	34	2.618	1.074	17.6	26.5	35.3	17.6	2.94		100
IT contribution	Scope of work increases by computing	34	3.647	0.646			44.1	47.1	8.82		100
	Able to discuss needs	34	3.441	0.824		11.8	41.2	38.2	8.82		100
	Satisfied with application	34	3.088	0.900		29.4	38.2	26.5	5.88		100
	Satisfied with response time	34	3.000	1.101	11.8	17.6	35.3	29.4	5.88		100
	Satisfied with access to data	34	3.294	0.871		23.5	26.5	47.1	2.94		100
	Satisfied with data sets	34	3.324	0.976		26.5	23.5	41.2	8.82		100

Demographic Profile of Business Customers

The majority or 57% of the respondents are holding non-executive positions in their organizations, with 60% of them come from forwarding companies. Many of them range from 36 to 45 years old with the majority of them come from the Malay ethnic background (80%) and having the Malaysian Certificate of Education as their highest education qualification (70%). About 80% of them do not own laptops and 69% of them have no Internet connection at home. However, 74% of them connect to the Internet at their respective offices. The majority or 57% of the clients report that they have experienced in using the Internet. Almost all the respondents claim that they are familiar with the C8 process (91.4%), with 51% of them familiar with the CIS C8 interface. About 77% of the respondents reported that they declare the C8 at the terminal stationed at the RMC's office, while 14% of them perform the declaration at the EDI-enabled facilities outside the RMC's office.

Level of Perceived Satisfaction of Business Customers

Table 3 shows the results of descriptive statistics with regards to the satisfaction level of the forwarding agents, importers, and bonded warehouse licensees on the various CIS implementation issues. Among the variables, the contribution of IT in terms of the satisfaction level of the overall CIS scores the highest mean (3.42), followed by IT facilities (3.38), and the present IT environment (3.37). The variables of the effect of technology and systems on effectiveness and IT in relation to socio-technical interface score the lowest mean of 3.25 each. Again, the RMC customers are rather indecisive and/or doubtful with their responses, judging from the mean scores of between 3.25 and 3.42. However, compared with the mean scores obtained from the RMC officers, its customers seem to record higher satisfaction.

In terms of the individual items, the mean score is within the range of neutral for most of the items, looking at the mean score of between 3.00 and 3.70. Only four items were found to

score above or equal to 3.50. They are "scope of works increases by computing", "able to discuss needs", "effective information delivery", and "sufficient data communication". The satisfaction with browsing speed remains the lowest scored item (mean=3.00). To some extent, some support is found for the rates of satisfaction or dissatisfaction shown by the respondents although many of them rated the items within the range of neutral. The standard deviation scores for most of them items are below 1, indicating consistency in the respondents' answers.

Table 3: Descriptive Statistics of Perceived Satisfaction among the External Customers

	Descriptive Statistics	No	Mean	Std. Deviation	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Missing	Total
					Percentage						
Present IT	Faster information	35	3.3	0.98	5.7	14	34	40	5.7		100
	Effective information delivery	35	3.5	0.82	2.9	5.7	31	54	5.7		100
	Easy to analyze data	35	3.4	1.09	5.7	14	29	37	14		100
	Friendly IT environment	35	3.3	1.15	8.6	14	34	29	14		100
IT Facilities	Computer at workplace	35	3.3	1.12	5.7	17	40	20	17		100
	Software at workplace	34	3.4	0.98	2.9	17	29	40	8.6	2.96	100
	Technical support at workplace	35	3.4	0.95	2.9	11	37	37	11		100
	IT system at workplace	35	3.4	0.88	2.9	11	34	46	5.7		100
	Version of software used	35	3.4	0.91	2.9	11	40	37	8.6		100
	Reliability of equipment & peripheral	35	3.4	0.88	2.9	8.6	46	34	8.6		100
IT in relation to socio-technical interface	Regular hands-on workshop	35	3.1	1.06	5.7	26	34	26	8.6		100
	Frequent upgrade of PC	35	3.1	1.02	5.7	23	31	34	5.7		100
	Sufficient data communication	35	3.5	0.95		17	34	34	14		100
	Appropriate computer resources	35	3.4	0.88	2.9	11	34	46	5.7		100
	Appropriate software	34	3.4	0.93	2.9	11	31	43	8.6	2.96	100
	Good documentation	35	3.4	1.04	5.7	11	29	43	11		100
	Sufficient training	35	3.1	0.98	5.7	20	40	29	5.7		100
	Sufficient consulting	35	3.1	0.91	2.9	20	43	29	5.7		100
	Sufficient supporting staff	35	3.2	0.92	5.7	17	34	40	2.9		100
	Effective supporting staff	35	3.2	0.95	2.9	11	43	34	8.6		100
Technology and Systems that affect the effectiveness	Screen layout & design appropriate	35	3.3	0.91		2.9	57	34	5.7		100
	Config of color &background clear/harmonious	35	3.4	0.65		2.9	57	34	5.7		100
	Screen guidance is clear and easy	35	3.4	0.88	2.9	11	37	43	5.7		100
	Easy access to info	35	3.3	0.98	8.6	5.7	43	37	5.7		100
	Information credibility	35	3.4	0.94	5.7	8.6	34	46	5.7		100
	IT infrastructure is reliable and safe	35	3.3	0.87	2.9	8.6	49	31	8.6		100
	No problem during navigating	35	3.1	0.96	5.7	17	43	29	5.7		100
	Rarely gets disconnected	35	3.1	0.91	5.7	17	46	29	2.9		100
	Satisfactory browsing speed	35	3	0.95	5.7	23	37	31	2.9		100
IT contribution to organization	Scope of work increases by computing	34	3.7	0.94		11	26	40	20	2.96	100
	Able to discuss needs	35	3.6	0.74		2.9	46	40	11		100
	Satisfied with application	35	3.4	0.88		17	37	37	8.6		100
	Satisfied with response time	35	3.1	0.93	2.9	23	40	29	5.7		100
	Satisfied with access to data	35	3.3	0.85		20	40	34	5.7		100
	Satisfied with data sets	35	3.4	0.81		11	49	31	8.6		100

DISCUSSION AND IMPLICATIONS

In terms of the demographic and psychographic profiles of the respondents, the findings imply that despite age and education level, the majority of both the types of respondents have experienced Internet usage and are familiar with the C8 process and the CIS. This is probably due to the training provided by the RMC to its officers and customers. However, both groups indicate that the training they received is insufficient, looking at the mean scores obtained for the items measuring sufficiency of training and hands-on knowledge. Among the main areas that warrant attention from the policy makers in this section include the rate of the RMC officers who are unable to access to the Internet and thus the C8 CIS at their workplace. It is also contrary to expectation when the business customers report that they are more familiar with the C8 process than the RMC officers. The level of understanding of the RMC officers and customers toward the C8 CIS is also questionable, judging from the fact that only a simple majority of them understand the CIS.

As far as the mean scores are concerned, the study has successfully achieved its objectives by providing answers to the three research questions. It is obvious that the level of IT utilization among the RMC officers and its customers, particularly through the use of C8 CIS is still low. This is attributed to the lack of an environment and facilities conducive for IT implementation, top management support, and socio-technical conditions. All these have somehow created doubts among the officers on the effectiveness of the CIS utilized which have prevented the officers from using the CIS to a level of their satisfaction. Nevertheless, the majority of the clients who use the CIS at the terminals stationed at the RMC's office claim higher satisfaction levels to the items surveyed, albeit still within the range of neutral. This leads to the answer for the second research question in which both the RMC officers and the customers surveyed are rather indecisive and/or doubtful with the CIS, again with the customers reporting higher satisfaction level compared to the RMC officers. The answers to the first and second research questions have implications on the third question, i.e. what are the areas that the bonded warehouse department should focus on to make sure that the implementation of its CIS C8 is successful.

On an overall, the study lends support to the debates on the applicability and practicability of e-government, specifically on the challenges it inherit from the process of its implementation. This implies a gap between the deliverables conceived and the actual realization of such e-government initiative (Sushil, 2008). It is evident that the implementation of e-government at the RMC is still in its infancy stage, in view that the agency is still struggling with the various hurdles concerning e-government implementation such as personnel, technical, and environmental conditions. These issues are not considered new but are in fact recognized as challenges facing governments in the early stage of e-government initiatives. The results show that the facilities and environment are not friendly enough to spur greater usage of the CIS among the officers. They are facing technical and socio-technical problems such as lack of relevant technical skills due to lack of top management support, training, and shortages of skilled personnel. In fact, the officers and customers seem to indicate that further improvements to the CIS and IT infrastructure such as browsing speed are necessary, in which the latter part contradicts with the ongoing government's efforts in developing sufficient infrastructure bandwidth. These issues have been transferred over to the customers, which resulted in lower levels of usage and satisfaction. To some extent, the findings show that the external customers are more satisfied with the CIS in many ways compared to the RMC's officers. This is probably due to the fact that the officers are able to accurately see the

shortcomings of the system as compared to their customers who have frequently been exposed to positive images of the system by the policy makers. In some ways, the results also imply that the government has been over-emphasizing on building technology infrastructure without really considering the acceptance of the stakeholders. With little top management support, there is an apparent lack of a conducive environment and facilities needed for successful IT implementation. It is therefore not surprising that the RMC officers and their clients cast doubt on their satisfaction levels.

The results imply that it is imperative for the RMC to reassess their CIS implementation from the perspectives of their internal and external customers. The agency can no longer take a neutral stand and must be open to any forms of reviews in order to stay relevant as an important public service provider. The satisfaction of both the internal and external customers must be fulfilled. In this case, the officers play an important role as they are the front liners to the system. Their perception and satisfaction levels will thus leave important implications to their customers.

To be successful in e-government initiative, vision, in-depth planning and implementation strategy are thus essential factors (Gil-Garcia and Pardo, 2005; Sushil, 2008) in order to reduce the associated risks, costs, and the time wasted (Ghapanchi et al., 2008). Central to e-government implementation is the objectives to be achieved, i.e. to improve the efficiency, transparency, accountability, and effectiveness of governments in better serving their constituents through the delivery of quality service. As such, public sector organizations such as the RMC must be prepared to embrace IT wholeheartedly if it is to become efficient and effective service providers and delivery agents to the citizens. The RMC needs to consider improving its internal management and control (Chu et al., 2008) through a change management mentality (Ghapanchi et al., 2008) so that a conducive environment is enabled to fuel growth of the CIS usage. The policy makers must be made to realize that any e-government initiative would be cumbersome without their full support and commitment. They will have to champion such initiative which must be cascaded down to the departmental levels of the RMC. The management of RMC should be made aware of the importance of CIS usage towards success in public service delivery and allocate adequate budget and resources to facilitate the support given to their officers and customers. It is imperative that the resources are used to improve the IT facilities and infrastructure, hire skillful personnel, and to provide periodic training to both the stakeholders. The training programs provide interaction opportunities among the officers, which might help the RMC to identify future improvements to the CIS.

Related to the above, as e-government involves various stakeholders, it is thus imperative that a holistic approach is taken to increase participation and collaboration with the officers, business entities, citizens and even other government entities when a system is designed or needs improvement, such as in the case of the CIS. It is obvious that the CIS needs to be revamped in order to enhance its usability as stressed in the respondents' answers. This is not uncommon as e-government is still evolving and people are still learning how to develop and manage this new technology. As such, Ghapanchi et al. (2008) suggest that e-government strategies should first target the improvement of their operations and processes and also the level of government's ability to cooperate. In this respect, any system is likely to generate development gains when it is closely adapted to the needs and capacities of the various stakeholders (Bhattacharyya, 2008) who might react differently to an innovation and therefore the degree of adaption (Chan et al., 2000). It is worth remembering that improved

interoperability between public organizations as well as between public and private organizations is of critical importance to make e-government more successful (Gottschalk and Solli-Saether, 2008; Reddick, 2008).

Once a system is designed and ready to be implemented, the policy makers and management of public sectors must think of how to increase the acceptance of the system by its stakeholders. Prior studies have identified factors such as perceived usefulness, trust, and persuasion which exert influence on the acceptance and intention to use e-government applications (Akpinar and Ondin, 2008; Tang et al., 2009). As such, any effort towards increasing acceptance of the CIS must be based on these factors. The officers must be convinced that the use of CIS helps them to complete their tasks on time and expose them to become more creative. At the same time, trust must be built with the customers through effective laws and policies. The customers must be able to see that the CIS meets their needs and that the RMC officers are friendly enough to be reached for advice and even suggestions on how certain aspects of the CIS can be further improved. In addition, it has been found that technology characteristics do not significantly influence the intention to use e-government applications. Therefore, it should provide a hint to the policy makers that continuous investment in technology does not guarantee usage, but rather picking the right technology that is able to fulfill the needs of both the internal and external customers is what matters most. More importantly, the technology and its associated facilities must be friendly enough to encourage usage on top of having sufficient bandwidth and technical integration which are deemed important to fulfill processes timely, quickly, and with minimum of wasted time and corruption (Ghapanchi et al., 2008).

CONCLUSION

In view of the rapid development of ICT infrastructure and environment in Malaysia, there is no doubt at all that the nation is prepared to embrace e-government towards achieving better service delivery performance for its citizens, businesses and other government entities (Tsai et al., 2009) despite the presence of many challenges. In fact, the success of e-government initiative in such as developing country like Malaysia has far-fetched implications. As Ghapanchi et al. (2008) put it, such an enabled government is a momentous opportunity for the developing countries to improve and streamline their government's operations, provide breakthrough performance, and reduce their existing gaps with the developed countries. It is therefore hoped that the recommendations provided above shed some lights to the policy makers and stakeholders in adapting appropriate IT strategies for e-government implementation success. Further, the findings can be used to guide future e-government projects in the country as well as other developing countries. From the research perspective, it is hoped that this study would spur more research in this area, especially among the developing countries.

Perhaps one of the major weaknesses of this study is the small sample size. A larger sample size across all the departments within the RMC and/or with other government agencies and diverse business entities may validate the arguments presented in this paper. It is possible for future studies to consider other important factors such as information quality (Burbridge, 2002; Klischewski and Scholl, 2008) security (Holden et al., 2003; Luna-Reyes and Gil-Garcia, 2003; Roy, 2003; Ryoo et al., 2009), technology incompatibility (Garson, 2003; Holden et al., 2003), policy and political pressures (Brown and Brudney, 2003; Edmiston, 2003; Rocheleau, 2003; Roy, 2003), privacy concerns (Edminston, 2003; Holden et al.,

2003), relationships between governments, business entities and citizens (Rocheleau, 2003), social and economical issues (Brown and Brudney, 2003; Edmiston, 2003; Holden et al., 2003) which are likely to generate important findings. In addition, prior research has shown evidence on the possible significant correlations between the IT issues and demographic factors such as age, education level, broadband access, experience in computer, Internet use, and frequency of Internet usage (e.g. Akpinar and Ondin, 2008; Dwivedi and Williams, 2008). An attempt on this may therefore yield interesting discoveries. Finally, this is a cross-sectional study. A longitudinal study is needed to capture the details.

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